Engineering Library

DEC 15 1928

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLVI.—No. 3803] LONDON: FRIDAY EVENING, NOVEMBER 30, 1928 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

SCHEDULE 1. 171 Sets of BODY FITTINGS for Bogie Carriages.

SCHEDULE 2. 10 LOCOMOTIVE BOILERS.

SCHEDULE 3. HYDRO-ELECTRIC PLANT, comprising four 12,000 kW Waterwheel-driven alternator sets, auxiliaries and spares.

Tenders due on the 18th December, 1928, for No. 1; on the 28th December, 1928, for No. 2; and on the 15th February, 1929, for No. 3.

Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 368

PROFESSOR OF MECHANICAL ENGINEERING, COLLEGE OF ENGINEERING, GUINDY, MADRAS.

Applications are INVITED for the PROFESSORSHIP of MECHANICAL ENGINEERING at the College of Engineering, Guindy, Madras.

Candidates should not be more than 40 years of age. They must hold an Honours Degree in Mechanical Engineering and have had practical experience.

Salary Rs. 1000 a month, rising by annual increments of Rs. 50 a month to Rs. 1500. An officer of non-Asiatic domicile will draw in addition overseas pay of £25 a month. Total minimum pay for officer of non-Asiatic domicile equivalent to approximately £1200 a year. Appointment on agreement for five years in first instance with possibility of extension. Free first-class passage to India for candidate and family. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1.

Last date for receipt of applications 31st December, 1928. 327

Crown Agents for the COLONIES.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/443. CIVIL ENGINEER REQUIRED by the Government of the Bahamas for the Waterworks and Sewerage Department for three years' service and possible extension. Salary £800 a year, with the prospect of rising to £1000 a year after about one year's service. Free passages. Candidates between 32 and 36 years of age (an abatement of the age limit is allowed on account of War Service), must have passed examination for A.M.I.C.E., or possess a degree in Civil Engineering recognised by the Institution as exempting from parts A and B of the examination. Must have had at least 8 years' practical experience on Waterworks and Sewerage construction and maintenance, of which at least five years should have been in the Colonies. Must have a knowledge of Waterworks management, the maintenance of Pumping Stations, Reservoirs, Water Softeners, Chlorinating Plants, Water Towers, Water Mains, House Connections, and Meters. Must also have a knowledge of working of Sewers, Ejector Stations, Sedimentary Tanks and Activated Sludge Plant.

M/987. ASSISTANT ENGINEER REQUIRED for Waterworks Construction in Nigeria under Consulting Engineers. Required to sail on the 5th of December for a tour of 12 to 18 months' service. Salary, £600 a year; free quarters and passages; outfit allowance of £80 on first appointment; liberal leave on full salary. Candidates, age 27 to 32, must be Associate Members of the Institution of Civil Engineers, and preferably have had some experience on Waterworks Construction.

Apply at once by letter, stating age and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 370

The High Commissioner for India is prepared to receive APPLICATIONS for the POST of ASSISTANT SUPERINTENDENT OF STORES in the BUILDINGS AND ROADS BRANCH, PUBLIC WORKS DEPARTMENT OF THE GOVERNMENT OF BURMA. Candidates must possess a University Degree in Civil or Mechanical Engineering, or, in lieu thereof, the Diploma of A.M.I.C.E. In addition, they should have had at least two years' practical experience in the purchase and distribution of common engineering construction materials. Age should be between 25 and 30 years. Agreement for five years in first instance. First-class passage out and home. Provident Fund. Pay on age scale, e.g., for an officer of non-Asiatic domicile, age 25, Rs. 475 a month plus overseas pay of Rs. 150 a month; 28 years, Rs. 575 plus overseas pay of £15 a month. The scale continues by increments of Rs. 50 to a maximum of Rs. 975 a month plus overseas pay of £30 a month. In addition to pay the officer will draw monthly certain local allowances. The sterling equivalent of the total emoluments drawn by an officer of non-Asiatic domicile aged 25 years would be approximately £857 per annum. At 30 years the approximate figure would be £970 p.a.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for the receipt of applications 22nd December, 1928. 348

The Government of Madras REQUIRE the SERVICES of a DREDGING SUPERINTENDENT for Cochin and Tuticorin Harbour Works. Must have at least 15 years' practical dredging experience, including 5 years as dredging master. Good knowledge of suction dredging and reclamation on a large scale specially required. Must be energetic, in robust health and not over 45 years of age.

Two years' agreement. Pay at the rate of Rs. 1000 per calendar month for the first year and Rs. 1050 for the second year, and bonus scheme. Free passages under the usual rules. Strict medical examination.

Forms of application and further particulars may be obtained upon request by postcard, from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 12th December, 1928. 350

The Engineer

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PUBLIC NOTICES

Civil Service Commission.

FORTHCOMING EXAMINATION : MECHANICAL ENGINEERING DRAUGHTSMEN in War Department Establishments (open to ex-Service men over 24 years of age).

Regulations and particulars are obtainable from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, together with the form on which application must be made. The latest date for the receipt of application forms is 20th December. 279

The University of Sheffield.

DEPARTMENT OF MECHANICAL ENGINEERING.

PROFESSOR : F. C. LEA, D.Sc., M. Inst. C.E., M.I. Mech. E.

The Council is about to APPOINT an ASSISTANT LECTURER and DEMONSTRATOR in MECHANICAL ENGINEERING.

Candidates should have an Honours Degree in Engineering and preference will be given to an applicant who has had practical experience in Heat Engines and Electrical Engineering.

Salary £300 per annum.

Applications should reach the undersigned not later than December 7th, from whom further particulars can be obtained.

W. M. GIBBONS, Registrar.

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The Institution of Mechanical ENGINEERS.

THE SECOND THOMAS LOWE GRAY LECTURE, 1928.

Professor WILLIAM E. DALBY, F.R.S., Vice-President, will deliver the above Lecture on "THE POSSIBLE VIBRATION OF A SHIP'S HULL UNDER THE ACTION OF AN UNBALANCED ENGINE" at the Institution, Storey's-gate, Westminster, on FRIDAY, 30th NOVEMBER, 1928, at 6 p.m.

VISITORS ARE INVITED. 306

PUBLIC NOTICES

County Borough of Halifax.

ELECTRICITY DEPARTMENT.

BOILER-HOUSE PLANT.

The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of TWO WATER-TUBE BOILERS, together with SUPERHEATERS, MECHANICAL STOKERS, ECONOMISERS, AIR HEATERS, FEED PUMPS, and ONE STEEL BUILDING for housing of same.

Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.

Sealed Tenders, endorsed "Tender for Boiler-house Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

PERCY SAUNDERS, Town Clerk.

Town Hall, Halifax, 13th November, 1928. 202

County Borough of Halifax.

ELECTRICITY DEPARTMENT.

TURBO-GENERATOR.

The Halifax Corporation are prepared to receive TENDERS for the SUPPLY and ERECTION of ONE 6500-kW M.C.R. GENERATOR and AUXILIARIES at the Foundry-street Generating Station, Halifax.

Specification and form of Tender may be obtained on application to the Engineer and Manager, Electricity Offices, Town Hall-street East, Halifax, upon payment of a deposit of £2, which will be returned only after a bona fide Tender has been received.

Sealed Tenders, endorsed "Generating Plant," must be delivered to the undersigned not later than Friday, December 7th, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

PERCY SAUNDERS, Town Clerk.

Town Hall, Halifax, 13th November, 1928. 203

The Adelaide Electric Supply CO., Ltd., having changed over from D.C. to A.C. in certain of their districts, offer FOR SALE a number of D.C. MOTORS, FANS, &c.—Particulars from their LONDON OFFICE, 27-28, Finsbury-square, E.C. 2. 319

PUBLIC NOTICES

In the High Court of Justice 1928 H.049
Chancery Division
Mr. Justice Clauson.
In the Matter of HENRY CRAWSHAY AND COMPANY LIMITED and REDUCED,
and
In the Matter of THE COMPANIES (CONSOLIDATION) ACT 1908.

Notice is Hereby Given that a Petition for confirming the reduction of the capital of the above Company from £140,000 to £119,000 was on the 25th October 1928 presented to the High Court of Justice and is now pending. A list of the persons admitted to have been creditors of the Company on the 25th October 1928 (the date fixed by Order dated 26th November 1928) may be inspected at the offices of the Company at Lightmoor Colliery Cinderford in the County of Gloucester or at the office of Messrs. Wellington Clifford and Matthews Solicitors 1 Berkeley-street Gloucester at any time during usual business hours, on payment of the charge of one shilling.

Any person who claims to have been on the said 25th October 1928 and still to be a Creditor of the Company, and who is not entered on the said list and claims to be so entered, must on or before the 17th December 1928 send in his name and address, and the particulars of his claim and the name and address of his Solicitor (if any) to Gilbert Trevor Wellington Esquire a member of the said firm of Wellington Clifford and Matthews at 1 Berkeley-street Gloucester aforesaid or in default thereof he will be precluded from objecting to the proposed reduction of capital.

Dated this 26th day of November 1928.

GIBSON & WELDON, 27, Chancery-lane, London, W.C. 2.
Agents for :
WELLINGTON CLIFFORD & MATTHEWS, of Gloucester,
Solicitors for the said Company.
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Broadstairs and St. Peter's URBAN DISTRICT COUNCIL.

MAIN DRAINAGE SCHEME.

CONTRACT NO. 2.

TO CONTRACTORS.

The Urban District Council of Broadstairs and St. Peter's are prepared to receive TENDERS for the CONSTRUCTION of about 4600 YARDS of STONEWARE SEWERS of 9in. and 12in. in diameter and about 2330 YARDS of CONCRETE TUBE SEWERS of 18in., 24in., 27in., and 30in. in diameter, together with all MANHOLES, VENTILATING SHAFTS and other appurtenant WORKS, in accordance with the plans and specification prepared by the Engineer, Mr. Godfrey M. C. Taylor, Caxton House, Westminster, S.W. 1.

Contractors desirous of tendering can obtain copies of the general conditions, specification, bill of quantities and form of Tender from, and may inspect the drawings at the offices of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender. Drawings may also be inspected at the offices of the Council at Pierremont Hall, Broadstairs.

Sealed Tenders, endorsed "Main Drainage, Contract No. 2," must be delivered to the undersigned at the Council Offices, Pierremont Hall, Broadstairs, before Twelve Noon on Monday, the 17th day of December, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

By Order of the Council,
(Signed) E. F. OWEN,
Clerk to the Council.

Pierremont Hall, Broadstairs, 26th November, 1928. 313

Broadstairs and St. Peter's URBAN DISTRICT COUNCIL.

SURFACE WATER DRAINAGE.

CONTRACT NO. 3.

TO CONTRACTORS.

The Urban District Council of Broadstairs and St. Peter's are prepared to receive TENDERS for the CONSTRUCTION of SURFACE WATER SEWERS, 9in., 12in., 15in., 18in., 24in., and 39in. in diameter, together with a SHORT LENGTH of SEA OUTFALL and also MANHOLES and other appurtenant WORKS, in accordance with the plans and specification prepared by the Engineer, Mr. Godfrey M. C. Taylor, Caxton House, Westminster, S.W. 1.

Contractors desirous of tendering can obtain copies of the general conditions, specification, bill of quantities, and form of Tender from, and may inspect the drawings at the office of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender. Drawings may also be inspected at the offices of the Council at Pierremont Hall, Broadstairs.

Sealed Tenders, endorsed "Surface Water Drainage, Contract No. 3," must be delivered to the undersigned at the Council Offices, Pierremont Hall, Broadstairs, before Twelve Noon on Monday, the 17th day of December, 1928.

The Council do not bind themselves to accept the lowest or any Tender.

By Order of the Council,
(Signed) E. F. OWEN,
Clerk to the Council.

Pierremont Hall, Broadstairs, 26th November, 1928. 314

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PUBLIC NOTICES

Great Southern Railways.

The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of :—

FINISHED WAGON WORK MATERIAL.

The form of Tender has been divided into five sections as follows :—

SECTION 1.—WHEELS and AXLES COMPLETE, and SPRINGS.
SECTION 2.—AXLE-BOXES COMPLETE.
SECTION 3.—BODY WORK, UNDERFRAME WORK, BRAKE WORK.
SECTION 4.—CAST IRON WORK.
SECTION 5.—ROOFING.

The drawings for all the items in each section, together with the specification and form of Tender (on which alone offers will be considered) can be obtained, on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of 5s. per section.

Tenders should be forwarded so as to reach the undersigned not later than 5 p.m. on Monday, December 17th, in the envelope provided for the purpose.

The Directors do not bind themselves to accept the lowest or any Tender.

H. S. COE,
Secretary.

Kingsbridge Station, Dublin,
November, 1928. 345

COOKING APPARATUS.

The Committee of Visitors of

the County Mental Hospital, Prestwich, invite TENDERS for the SUPPLY and FIXING of STEAM and ELECTRICAL COOKING APPARATUS and other EQUIPMENT at the Annexe Kitchen.

Full particulars may be obtained on application at the Hospital or by letter from the undersigned.

A. E. DOWLING,
343 Clerk and Steward.

Limerick Harbour Commissioners.

TO CRANE ENGINEERS.

The Limerick Harbour Commissioners are prepared to receive TENDERS for the SUPPLY of a 5-TON HAND PORTABLE CRANE.

Copies of the outline specification may be obtained on application to the Harbour Engineer, Engineer's Office, Docks, Limerick.

Tenders must be addressed to the Chairman, Limerick Harbour Commissioners, Harbour Office, O'Connell-street, Limerick, and must be delivered not later than Twelve o'clock Noon on Saturday, 15th December prox.

The lowest or any other Tender will not necessarily be accepted.

JOHN F. POWER,
294 Secretary.

London Power Company, Ltd.

DEPTFORD WEST POWER STATION.

APPLICATIONS are INVITED for the following APPOINTMENTS in connection with the Deptford West Power Station.

FOUR CHARGE ENGINEERS with experience with large capacity Turbo Alternators and E.H.T. systems. Salary, £450 per annum.
FOUR BOILER-HOUSE CHARGE ENGINEERS with experience in control of modern boiler plant. Salary, £400 per annum.
FOUR SWITCHGEAR CONTROL ROOM OPERATORS, at £5 10s. per week.
FOUR ASSISTANT SWITCHGEAR CONTROL ROOM OPERATORS, at £3 19s. per week.

Applications in writing, to be addressed to the ENGINEER-IN-CHIEF, London Power Company, 14 1, Ergon House, Horseferry-road, Westminster, S.W. 1. 363

Municipality of Singapore,

STRAITS SETTLEMENTS.
ELECTRICITY DEPARTMENT.
FOUR CHARGE ENGINEERS.

FOUR CHARGE ENGINEERS are REQUIRED by the Municipal Commissioners of Singapore for service at their New Power Station, the appointments being on the permanent staff of their Electricity Department and being in the first instance upon three years' agreements.

The capacity of the plant first installed was 12,000 kilowatts, with an extension of 10,000 kilowatts now in progress.

Candidates should have a thorough experience in extra high-tension three-phase generation, steam turbines, water-tube boilers, and mechanical stokers, and must have held a similar position for at least two years.

Strict medical examination required.

Salary, 5040 dollars, 5520 dollars and 6000 dollars per annum respectively for the three years of the agreement, and rising thereafter (if service be continued) in accordance with the Commissioners' salary scheme. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £588. There is at present no income tax. Free partially furnished quarters provided with an allowance for lighting.

Free passages will be provided with half salary during voyage out. Eight months' leave with full pay is normally granted after four years' service. Liberal Provident Fund.

Applications, stating whether married or single, and giving age and birthplace, with details of education, training and experience, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Monday, 10th December, 1928.

Further particulars, if desired, can be obtained from the Agents.

N.B., 27-11-28.—This advertisement cancels the similar advertisement for one "Charge Engineer" recently published by the Agents. 353

Southport, Birkdale and West Lancashire Water Board.

DISTRIBUTION SUPERINTENDENT.

The Water Board invite APPLICATIONS from persons with the necessary qualifications and experience for the APPOINTMENT of DISTRIBUTION SUPERINTENDENT, at a salary of £300 per annum.

Applicants must be under 40 years of age, and should have a thorough practical experience of mainlaying and repairing, plumbing and fittings inspection, waste detection and the control of outdoor staff and workmen of a waterworks undertaking.

The appointment will be made subject to the provisions of the Local Government and Other Officers Superannuation Act, 1922, and the successful candidate will be required to pass a medical examination.

Applications, in candidates' handwriting, upon special forms provided, and accompanied by three recent testimonials, must reach the undersigned not later than 19th December, 1928, endorsed "Distribution Superintendent."

C. BURTON EDE, M. Inst. C.E.,
Engineer and Manager.

14, Portland-street, Southport,
27th November, 1928. 361

The South Metropolitan Gas Company

invite APPLICATIONS for the POST of DEPUTY CHIEF CIVIL ENGINEER. Commencing salary £800. The position carries no responsibility pertaining to the management of the works nor of the employees, but is concerned wholly with the design and construction of the plant required by the Company's operations from the coal unloading wharves on the Thames to the gasholders.

Knowledge of chemistry and of physics is essential.

The successful candidate will participate in the superannuation and profit-sharing benefits, and will be required to pass a medical examination.

Applications, setting forth chronologically the qualifications of the applicant, should be accompanied with a copy only of one testimonial and be received by the undersigned not later than December 10th, endorsed "Civil Engineer" in the left-hand corner of the envelope.

FRANK DAY,
Secretary.

South Metropolitan Gas Company,
709, Old Kent-road,
Peckham, S.E. 15,
26th November, 1928. 315

ARNOLD BOOKS

A BIBLIOGRAPHY OF METALLIC CORROSION.

By W. H. J. VERNON, D.Sc., formerly Senior Investigator to the Atmospheric Corrosion Committee, British Non-Ferrous Metals Research Association.
With an Introduction by Professor H. C. H. CARPENTER, F.R.S. xii + 324 pages. **21s.** net.

THE CORROSION OF METALS.

By U. R. EVANS, M.A., King's College, Cambridge. SECOND EDITION. xvi + 259 pages. **15s.** net.

THE ECONOMICS OF RAIL TRANSPORT IN GREAT BRITAIN.

By C. E. R. SHERRINGTON, M.A., A.M. Inst. T., Lecturer on Transport and Secretary of the Railway Research Service, at the London School of Economics. Two Volumes, obtainable separately.

VOLUME I. History and Development. xii + 283 pages. **12s. 6d.** net.
VOLUME II. Rates and Service. xii + 332 pages. **12s. 6d.** net.

"This is easily the most important work upon railway economics in this country that has appeared for a generation . . . The whole work is a clever and conscientious contribution to the new outlook, and must take rank at the outset as standard in its own field."—SIR JOSIAH STAMP in *The Spectator*.

THE ECONOMICS OF COAL-MINING.

By R. W. DRON, M.A., M. Inst. C.E., Professor of Mining in the University of Glasgow. viii + 170 pages, 13 diagrams. **10s. 6d.** net.

BRITISH ENGINEERING WAGES.

By ROBERT SPICER. With many Tables and Diagrams. **10s. 6d.** net.

"He deals with the whole subject in an impartial spirit. His conclusions will, to say the least of it, lead to stimulating and provocative discussion among those who read his book."—*Midland Daily Telegraph*.

LONDON EDWARD ARNOLD & CO. 41 & 43 MADDOX ST. W.

PUBLIC NOTICES

Administrative County of London.

REBUILDING OF LAMBETH BRIDGE.
APPOINTMENT OF A RESIDENT ENGINEER.

The London County Council invites APPLICATIONS for the POSITION of RESIDENT ENGINEER in connection with the rebuilding of Lambeth Bridge over the River Thames between Westminster and Lambeth.

The appointment will be upon the temporary staff; selected candidate will be appointed by and serve under the direction of the Council's Chief Engineer.

The salary will not exceed £800 a year inclusive.

Candidates must be Corporate Members of the Institution of Civil Engineers. Practical experience with an engineer or contractor in control of works of bridge construction or other works of a similar character, involving the sinking of caissons under compressed air, is essential, and candidates must be physically fit to the satisfaction of the Council's Medical Examiner for compressed air work.

Forms of application may be obtained either by personal call at the County Hall (Room 216) or by sending a stamped addressed foolscap envelope, marked "Resident Engineer, Lambeth Bridge," to the Clerk of the Council, The County Hall, Westminster Bridge, S.E.1. The latest time for receiving applications is Monday, 17th December, 1928. Canvassing disqualifies.

MONTAGU H. COX,
332 Clerk of the London County Council.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

BOX P. 5188, The Engineer, Nov. 16.—APPLICANTS are advised that the POST ADVERTISED has been filled.—Address, P5251, The Engineer Office. P5251 A

WANTED, an ENERGETIC MAN, to Take Charge of Sales of a well-known make of Electric Arc Welding Plant and Welding Metals; must have had both Electrical and Metallurgical training.—Write, giving qualifications, experience, &c., to Z.X. 888, care Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 233 A

WANTED, ASSISTANT ROLL DESIGNER; Must have designing experience and be capable of undertaking standard and special sections. Prospects for right man.—Apply, stating age and experience, to FRODINGHAM IRON and STEEL CO., Ltd., Scunthorpe, Lincs. P5238 A

WANTED, First-class SALESMAN by Well-known firm specialising in Machinery Drive and Pressure Pumps. Applicants must have necessary connection.—Apply, giving all particulars and salary required, to Box 38, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 316 A

WANTED for India, ENGINEERING ASSISTANTS, age 24-26, unmarried. Headquarters in Calcutta. Applicants should have sound engineering training and drawing-office experience, preferably in Structural Steel Work. Public school type preferred.—Applications, with full particulars, should be addressed to Box 375, Leathwait and Simmons, 34, Throgmorton-street, London, E.C. 2. P5232 A

A COMMERCIAL ENGINEER of Proved Selling ability is offered an exceptional opportunity of earning a substantial income by an important firm of Machine Tool Manufacturers and Factors in London.

Applicants are requested to submit a few concise particulars of their experience to E. L. S. at Hornoastle's, 60, Cheapside, E.C. 2. P5236 A

A FIRM of CHEMICAL MANUFACTURERS DESIRE the SERVICES of an ASSISTANT PRODUCTION MANAGER, who would also act as ASSISTANT WORKS MANAGER.

The candidate must have experience in Chemical Engineering, be a good organiser, and be able to conduct (if necessary) such correspondence as will arise in the Production Department.

The Company, which owns several works at home and abroad, does a large and extensive business in proprietary articles, so that the duties of the successful candidate would embrace chemical engineering, production of goods, and their packing and labelling.

Commencing salary offered is £400 per annum; the prospects of advancement for a suitable candidate are considerable.

Full particulars address, P5246, The Engineer Office. P5246 A

SITUATIONS OPEN (continued)

ACCOUNTANT (Unmarried) WANTED, to Take Charge of Books of Builders and Contractors in Calcutta. Sound training in similar capacity essential. Passage paid. Agreement for four years. Salary Rupees 500, 550, 600, 650 per mensem.—Apply in writing, stating age, full particulars and copies of recent testimonials, to ANNAN, DEXTER and CO., Chartered Accountants, 21, Ironmonger-lane, London, E.C. 2. 336 A

ASSISTANT ENGINEER WANTED for the Office of a Consulting Engineer for India. Must be of college education and sound practical works experience, able to design, estimate and supervise General Mechanical and Electrical Work. Must be A.M.I.C.E. and also preferably A.M.I.E.E., age 25 to 35 and unmarried. Salary £750 per annum and first-class passage to India with travelling expenses.—Apply in the first place to Post Box 2240 Calcutta, with detailed particulars of experience and education. 296 A

ENGINEER WANTED for Power Transmission Appliance, with technical training, knowledge of machine design and estimating and works experience. Salary £500.—Address, P5242, The Engineer Office. P5242 A

ENGINEER WANTED by Large Company in London for a period of eighteen months to two years. Must have experience on the steam side of Central Electricity Station, and be capable of compiling specifications for Boilers, Pipework, &c.—Write, stating age, qualifications and experience, and when free, "F. R.," c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 367

ENGINEERS' STOREKEEPER.—WANTED, a practical ENGINEERS' STOREKEEPER, to Take Control of a Stores and Stores Staff in a large manufacturing concern. State previous experience, with copies of recent testimonials, age, and salary required.—Address, 331, The Engineer Office. 331 A

EXPERIENCED ENGINEER REQUIRED as Travelling Representative Consultant in Heat Transfer Apparatus. State age and full qualifications.—Address, P5224, The Engineer Office. P5224 A

FERRO-CONCRETE.—ENGINEER, with a Good Degree and about three years' specialist experience in Ferro-concrete Design and Construction, REQUIRED.—Apply (by letter only), giving full details of training and experience, stating salary required, to K. HOLST and CO., 1, Victoria-street, S.W. 1. 339 A

REQUIRED by Firm of Gearing Specialists Having headquarters in London, ENGINEER-SALESMAN, to travel throughout the country. Technical training and previous travelling experience essential.—Write, giving full details as to age, experience, education, and salary required, to Box 84, c/o Mather and Crowther, Ltd., 10-13, New Bridge-street, E.C. 4. 317 A

REQUIRED for Important British-owned Railway in Argentina, ENGINEER, to Take Charge of the Vehicle Running Section of the Mechanical Department. Must have a good working knowledge of the construction and maintenance of Railway Carriage and Wagon Stock and be a good organiser, able to take charge of repairs and maintenance throughout the railway system. Age not exceeding 35. Salary £1000 per annum on three years' agreement. Passage provided.—Reply, stating age, education, training and experience, with copies (only) of testimonials, to Box L. W. G., c/o Davies, 95, Bishopsgate, London, E.C. 2. 310 A

REQUIRED, FOUR First-class STRESS-MEN, with experience of Detail Stressing and Air Ministry requirements.—State age, experience and salary required to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 175 A

WORKS ENGINEER WANTED to Take Charge of large plant; must be able to control labour. State age, experience and salary required.—Address, 354, The Engineer Office. 354 A

WORKS MANAGER REQUIRED, Experienced in Foundry and Machine Shop Practice, for works producing heavy Non-ferrous Castings and employing about 100 men; must have first-class organising ability and be efficient engineer.—Address, stating qualifications, experience, age, salary required, &c., 362, The Engineer Office. 362 A

WORKS MANAGER WANTED for Machine Shop near London employing 100 on light work. Experience of modern production and costing methods required. State salary.—Address, P5243, The Engineer Office. P5243 A

SITUATIONS OPEN (continued)

WANTED by a Firm of Crane Manufacturers, a LEADING DRAUGHTSMAN with up-to-date knowledge and experience in Crane Work. Knowledge of designing an advantage.—Address, fully stating age, experience, and salary required, 308, The Engineer Office. 308 A

WANTED for London Office, TWO or THREE DETAILING DRAUGHTSMEN, accustomed to Detailing Steel-framed Buildings. State, age, experience and salary required.—Address, 201, The Engineer Office. 201 A

WANTED, Expert STRUCTURAL STEEL DRAUGHTSMEN for immediate employment.—Write, HAMILTON BRIDGE CO., Hamilton, Canada. 323 A

WANTED, First-class DRAUGHTSMAN, Used to Hydraulic Machine Tool Work.—Address, 9955, The Engineer Office. 9955 A

WANTED for London District, Competent DRAUGHTSMAN, with good experience in the design and application of Shock Absorbers to heavy vehicles. Full particulars, age, experience, and salary required, &c.—Address, 346, The Engineer Office. 346 A

CHIEF DRAUGHTSMAN (LOCOMOTIVE).—Applications, in writing, will be considered till 15th December, 1928, for fully qualified Engineer. Must have held a similar position in the drawing-office of a locomotive engineering firm of good standing.—State previous experience and remuneration expected, enclosing testimonials (copies only), to NORTH BRITISH LOCOMOTIVE COMPANY, Limited, 110, Flemington-street, Glasgow. P5240 A

DRAUGHTSMAN, Accustomed to Preparation of Contract Drawings required for Water Scheme, including Pumping Station, in South Wales. Must be neat and quick. Preference given to one who can level and survey. Period about twelve months. State salary required.—Applications not later than December 10th, 1928, to 337, The Engineer Office. 337 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9672, The Engineer Office. 9672 A

DRAUGHTSMAN REQUIRED, Accustomed to Producing Scheme Drawings and Projects for Conveyors and Mechanical Handling Plants; only men capable and used to working on their own initiative will be considered. State age, wages and experience.—Address, 357, The Engineer Office. 357 A

DRAUGHTSMAN REQUIRED for RAILWAY WORK, must be conversant with the design of Modern Railway Carriages and Wagons, &c. State experience, age, and salary required.—Address, 344, The Engineer Office. 344 A

DRAUGHTSMAN REQUIRED, with Experience of Machinery and Pipe Arrangements for Marine Work. A knowledge of Pulverised Fuel an advantage, but not essential.—Address, stating age, experience, and salary required, 358, The Engineer Office. 358 A

DRAUGHTSMAN WANTED, Experienced Man for Boiler Lay-outs; must be accurate and speedy. Knowledge of Powdered Fuel Firing a recommendation.—Address, 356, The Engineer Office. 356 A

DRAUGHTSMAN WANTED, Thoroughly Experienced in General Constructional Steel Work; no others need apply.—State age, salary and particulars of experience to THOMAS PIGGOTT and CO., Ltd., Atlas Works, Spring Hill, Birmingham. P5239 A

DRAUGHTSMAN WANTED.—First-class CRANE DRAUGHTSMAN, having experience of all types of Crane Designs and able to carry through complete job. State age, experience, and salary.—Address reply to CHAPLIN'S CRANE WORKS, Govan, Glasgow. 311 A

DRAUGHTSMAN, with First-class Experience of Steam Turbine design and detail work, for works in Midlands. State age, salary, experience, and when able to commence.—Address, 274, The Engineer Office. 274 A

ENGINEER and ESTIMATING DRAUGHTSMAN, with intimate knowledge of Chemical Process Plant, including Evaporating and Distilling Equipment, REQUIRED by Engineers, Glasgow. State full particulars and experience.—Address, 312, The Engineer Office. 312 A

ENGINEERING FIRMS in Lancashire, Making and Installing Fans and accessories, PROCURE thoroughly competent CHIEF DRAUGHTSMAN. State age, experience and salary required.—Address, 360, The Engineer Office. 360 A

EXPERIENCED MACHINE TOOL DRAUGHTSMAN.—Apply by letter, stating qualifications, to J. PARKINSON and SON, Shipley, Yorks. P5229 A

EXPERIENCED DRAUGHTSMAN and ESTIMATOR REQUIRED, well acquainted with the designing and construction of Coke Oven or Gas-works' Carbonising Plant. Knowledge of German language an advantage.—Write, stating age, experience, and salary, to ZO 150, c/o Deacon's, Fenchurch-avenue, E.C. 3. 386 A

MECHANICAL DRAUGHTSMAN, Preferably with Chemical Plant experience, REQUIRED.—Write, stating experience, age and salary desired, to Z.R. 152, c/o Deacon's, Fenchurch-avenue, London. 369 A

REQUIRED AT ONCE, SENIOR CRANE DRAUGHTSMAN, Birmingham district.—Address, 350, The Engineer Office. 350 A

REQUIRED, SIX First-class AERONAUTICAL DRAUGHTSMEN, with good experience on All-metal Construction, &c.—State age, experience, and salary required to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 174 A

FOUNDRY FOREMAN REQUIRED, Used to Machine Moulding. Only man used to moulding machine repetition work need apply, stating age, wage required, and experience.—Address, 247, The Engineer Office. 247 A

FITTER REQUIRED in Sussex. Used to the Erection of Elevators and General Heavy Plant.—Address, P5245, The Engineer Office. P5245 A

SITUATIONS WANTED

ADVERTISER, 27, Married, SEEKS POSITION with prospects; 6 years shops, 6 years D.O. Thorough knowledge, latest designs, manufacture, upkeep, steam and I.C. engines, tractors, rollers, &c.; keen, hard worker.—Address, P5249, The Engineer Office. P5249 B

DESIGNER-DRAUGHTSMAN (Mech.) (25), 4½ years' shop, 6 D.O. exp., in structural, hydraulic, chemical and general engineering, SEEKS POST in London.—Address, P5247, The Engineer Office. P5247 B

ENGINEER ENGAGED on Maintenance SEEKS PROGRESSIVE POST. Foundry, pattern, D.O., and good gen. exp., first-class B.O.T. Excellent refs.—Address, P5250, The Engineer Office. P5250 B

ENGINEER, Just Completed 9½ Years' Engagement as chief engineer to important preserve, chocolate and confectionery firm, SEEKS similar POSITION as Chief or Maintenance Engineer.—Address, P5200, The Engineer Office. P5200 B

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

American Naval Policy.

The Washington Navy Department has issued a long statement on the subject of United States naval policy. This document foreshadows the creation and maintenance of a navy "second to none," and throws new light on the Department's building plans. War efficiency and its maintenance "during the entire period of peace" is to be made the object of all training, and the Navy is to be developed and organised "for operations in any part of either ocean," *i.e.*, the Atlantic and the Pacific. In the design of all new ships superiority of armament is to be a guiding principle, but equal importance is attached to great radius of action. Detailed plans are to be prepared for new capital ships to replace existing vessels in the years specified in accordance with the Washington Treaty, for new aircraft carriers with the maximum stowage space for "heavy-class 'planes," and for the rapid conversion of suitable merchant vessels into aircraft carriers. In regard to cruisers the Department's policy is to replace all old ships with modern units of 10,000 tons, mounting 8in. guns, and "to build similar cruisers at a rate that will maintain effective cruiser tonnage in conformity with the capital ship ratios established by the Treaty"—in other words, to build up to equality with the British cruiser fleet. No cruisers smaller than the standard 10,000-ton type are to be built. The construction of flotilla leaders and submarines is to be undertaken, and the advancement of aviation promoted by all possible means. Finally, the Department intends "to encourage, and endeavour to lead in, the development of the art and material of naval warfare." It is to be assumed that this significant document has been issued with the full approval of the United States Government.

Launch of H.M.S. Resource.

H.M.S. "Resource," the first ship of the British Navy to be specially designed for repair duty, was launched on Tuesday, November 27th, from the works of Vickers-Armstrongs, Ltd., at Barrow-in-Furness. She was authorised under the five-year building programme, was laid down in August of last year, and is due to be completed during the autumn of 1929. She is a vessel of considerable displacement, her length overall exceeding 500ft. Unlike the submarine depôt ship "Medway," now being completed at Barrow, which is fitted with internal-combustion engines, the "Resource" will be driven by steam turbines with single-reduction gearing, taking steam from Yarrow oil-burning boilers. The plant is designed for an output of 7500 S.H.P. In conformity with the Admiralty's desire to make the Fleet self-supporting as regards all but major repairs, the "Resource" has been planned as a floating workship with exceptionally extensive and up-to-date equipment. All the machine tools will be operated by electricity. There are to be shops for the repair and maintenance of torpedoes and boats, a foundry, a smithy, and cranes for dealing with heavy weights. When completed the "Resource" is to replace the "Assistance," a converted merchant ship dating from 1900, which has become unserviceable and must soon be scrapped. Although the "Resource" is the only repair ship included in the five-year building scheme, there is a strong feeling in naval circles that at least one other vessel of this type should be provided. The cost of such a vessel would soon be more than balanced by the saving effected in dockyard expenditure and in the fuel bill of warships, which, in the absence of repair facilities afloat, often have to make long voyages to reach the nearest yard.

John Brown and Co., Ltd.

To commemorate his completion of fifty years' work as an engineer and his association for over forty-one years with John Brown and Co., Ltd., Sir William Ellis, at the beginning of this week, entertained to dinner in Sheffield a party of about two hundred, consisting of members of the staffs of the Atlas and Scunthorpe Works and the Aldwarke Main and Rotherham Main Collieries. Following the dinner Lord Aberconway, chairman of the company, announced that several important changes in the executive positions would come into operation on January 1st, 1929. By reason of advancing years Sir Charles E. Ellis, his lordship stated, was withdrawing from the senior managing directorship, but would remain a member of the Board and would retain his special association with the Clydebank shipyard. Sir William Ellis would resign his post as managing director at the Atlas Works and would become managing director of the company's collieries. It was felt, Lord Aberconway remarked, that the circumstances of the coal industry made it essential that the company's colliery interests should be represented by a managing director, and that in appointing Sir William to fill the position they were placing at the head of their colliery undertakings one who had a complete knowledge of the ramifications of the South Yorkshire coal trade and its technical difficulties. Mr. Allan J. Grant, a director, would succeed Sir William as managing director at the Atlas Works, Sheffield. Sir Charles Ellis has been a director of the firm for about thirty-six years, and was at the Bar before going to Sheffield to assist his father, the late Mr. J. D. Ellis. Sir William Ellis joined his father's staff in 1887 as under manager of the forge department, and has been a director of the firm for twenty-two years. During the course of his career he has, among other professional appointments, been President of the Institution of Civil Engineers, President of the Iron and Steel Institute, and for four years in succession during the war Master Cutler of Sheffield.

Lifeboat Equipment on the New German Liners.

One of the most interesting of the papers read at the annual meetings of the Schiffbautechnischen Gesellschaft, which took place in Berlin at the end of last week, was that presented by Director P. Biedermann, of the North German Lloyd Company, describing the lifeboat equipment on the new North German Lloyd liners "Bremen" and "Europa," which are to be placed on the Bremen–New York service next year. Each ship will carry twenty-two large motor lifeboats, each capable of carrying 135 persons. In addition to these main boats, there are to be four smaller motor lifeboats, each carrying twenty-five persons and provided with wireless equipment. Two rowing boats, or working boats, each of which will carry forty persons, complete the equipment. The total number of passengers and crew carried at any time on each of the new liners will be not more than 3140, and boat places are normally provided for 3150 persons. In addition, the large lifeboats are rated to carry an extra ten passengers, thereby giving a margin of 220 boat places. The davits are of the Welin-Maclachlan gravity type, with a new pattern of electrically operated boat winch. The winches are neatly arranged on the sun deck above the boat deck, so that the latter deck can be kept free for the assembling of the passengers and boat crews. The main lifeboats themselves possess several special features. They each have a length of 37ft. 8in. and a beam of 13ft. 5in. and a depth of 4ft. 7in. The hulls are constructed of steel, and air boxes are built into them, and also into five cross compartments. By this means the boats are rendered unsinkable. The propelling motor is of the "Penta" type, with a designed output of 20 B.H.P. at 1200 r.p.m., corresponding to a boat speed of about 6 knots. The engine is enclosed in a water-tight casing, and a water freeing pump driven from the engine is fitted.

The Reopened Port of Queenborough.

Early in the week an inspection of the Port of Queenborough was arranged by the new company, Port of Queenborough, Ltd., which has been formed to take over and develop the port for commercial purposes. It will be recalled that before the war Queenborough was used by the Southern Railway Company as the terminal port of its Flushing-Queenborough passenger service to the Continent, while during the war period it was a naval base. Although the port has remained practically unused since 1918, steps have been taken by the company, the Port of Queenborough, Ltd., to render it serviceable for shipping. The harbour has now been dredged, so that vessels up to 3000 tons capacity can berth or leave at any state of tide or in any weather. Lord Queenborough, who addressed the visitors to the port on Monday last, referred to the many advantages the port enjoyed. Although it was within the seaward limit of the Port of London, it was, he said, immune from dues on shipping and other charges levied under the Port of London Act. There was also, he pointed out, a large area of ground attached to the harbour which awaited commercial development. A regular line of steamers had used the port before, and he saw no reason why a line of steamers trading to the Continent should not again use it.

Emergency Aircraft Production.

In the course of a paper dealing with some of the production problems in the aircraft industry, read yesterday (Thursday) before the Royal Aeronautical Society, Mr. F. Sigrist, of the H. G. Hawker Engineering Company, dealt briefly with the vexed question of the production of aeroplanes in a time of emergency. The staff view of aerial warfare, Mr. Sigrist said, was that in the first clash of hostilities casualties in machines and *personnel* would be heavy, and that the side which could most rapidly re-equip itself would be the predominant party. The aeroplane industry ought therefore to be in a position to assume the *rôle* of a third line of defence. It could not, however, said Mr. Sigrist, accept such a *rôle* at present. The position was serious and would remain so until the industry was placed on a basis that would ensure continuity of output and obviate the prevalent high peaks and depressions. Under present conditions, he stated, if a sudden call were made on the industry for, say, one hundred varied machines within seven or even fourteen days, the chances of more than a 30 per cent. response being made were remote. He could not suggest how soon the output could be increased up to 200 machines a week. Even although production facilities could be rapidly expanded and the number of men required could be obtained, the engine question would still remain, and that question in its way seemed less capable of solution than the aircraft problem. The Air Ministry naturally hesitated to undertake extensive commitments in face of the rapid advance being made in aerodynamics and aero-engines. While he sympathised with it in its difficulties, he felt that the subject had not received the consideration which its importance merited.

A Motor Vessel for the Blue Star Line.

It is announced that the Blue Star Line (1920), Ltd., has placed an order with Palmers' Shipbuilding and Iron Company, Ltd., of Hebburn-on-Tyne, for a new 12,000-ton twin-screw motor vessel, which will be employed in its South American service. The new Blue Star Line steamers have made excellent trips, and recently, as recorded in these columns the owners have made satisfactory experiments with pulverised fuel on a cargo steamer, the "Stuartstar.' It is understood that the object of ordering the new motor vessel is to obtain exact comparative results for different types of propelling machinery operating under identical conditions. Work will be started on the new vessel forthwith. She will have a length of 485ft., with a beam of 68ft. Her propelling machinery will comprise twin sets of 4500 S.H.P. eight-cylinder Sulzer engines, having a bore of 680 mm. and a stroke of 1200 mm., and developing full power at 115 r.p.m. The main engines and also the oil engine driven generator sets for lighting and power will be built by Sulzer Brothers at Winterthur.

The B.B.C's. New Headquarters.

At an estimated cost of between £400,000 and £500,000 a new building is to be constructed in Portland-place, Oxford Circus, for the British Broadcasting Corporation. As soon as the work is complete the building will become the Corporation's headquarters, and no fewer than ten studios will be available for broadcasting. Four of these studios will be more than double the size of the largest studio at Savoy Hill, and one will be a "super" studio with an area of approximately 4000 square feet, and, together with its gallery, will be capable of accommodating an audience of 1000, as well as a large orchestra. All the latest ideas of acoustical treatment are to be embodied in this studio. The studios and their suites will be insulated from all external noise. They will be grouped one above the other in a central tower of heavy brickwork, ventilated artificially, and protected from street noises by the surrounding offices. Wide corridors and thick brick walls will insulate the studios from the offices. With a view to eliminating sound interference between studios, the central tower will be constructed without vertical steel work. The suite attached to each of the large studios will comprise a waiting room, a band room, engineers' room, a listeners' room, and an echo room. There will be eight rehearsal rooms, six writing rooms, a reception suite, and a special "dramatic effects" studio. It is hoped that the building will be ready for occupation in 1931.

The Oxford Process of Beet Sugar Extraction.

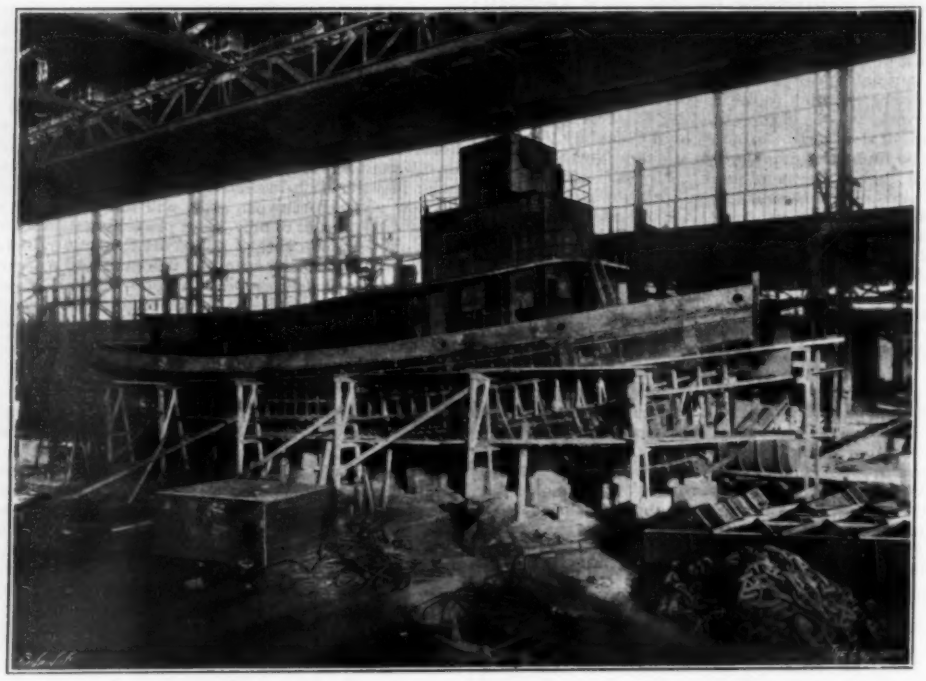
In The Engineer of April 22nd, 1927, we gave a fully illustrated description of the new method of making beet sugar, devised by Dr. B. J. Owen, director of the Institute of Agricultural Engineering at Oxford, and now in operation at Eynsham. A striking tribute is made to the commercial and scientific value of this process in a report by the French chemical engineer, Professor D. Sidersky, which was published last week. Professor Sidersky, who has studied the Owen process in detail, says that by spreading the production of sugar over at least 320 days instead of the usual "campaign" of 80 days, the factory with its extraction plant can be cut down to one-quarter its normal size. There is, he says, a notable saving in manual labour, which follows directly from the omission of several stages in the usual process, while the expenditure on such materials as coke and lime, oils and grease is substantially reduced. There is no increase in the coal used, as the cossettes are separately dried, and the extraction of sugar is much easier than from fresh beet slices. There is no loss of the order of 3 per cent. of sugar such as takes place in the usual process, so that there is a resultant gain in the sugar yield of 25 kilos., or close upon 56 lb. per ton of beet. Professor Sidersky, in summing up his report, says that the Oxford process, by reducing factory costs, promises to put the British industry on a permanent basis, giving a fair price to the farmer for the growing of the beet and a reasonable factory profit.

The Port of London.

Some interesting figures showing the pre-eminence of the Port of London were given in the course of a lecture by Mr. J. H. Estill, the Commercial Manager of the Port of London Authority, presented at the Society of Arts on Wednesday evening last, November 28th. The water area of the docks, he said, was 720 acres and there were 36½ miles of quays, while the whole area of the estate was 3234 acres. About 25 million tons of merchandise entered the port yearly, of which nearly 14 million tons came from overseas. One-third of the total trade of the United Kingdom was, Mr. Estill said, dealt with through London.

The Works at Montreal of Canadian Vickers, Ltd.

In the notable development of large industrial enterprises in Canada the achievements in the Vickers works at Montreal are of more than ordinary interest. This enterprise was taken over from English interests in the early part of 1927 by the firm of Canadian Vickers, Ltd. The works, views of which are given herewith and on page 593, are situated on the water



MOTOR TUG FOR KOOTENAY LAKE

front of Montreal Harbour and are one of the greatest assets of that port.

Among the leading activities of the company at the present time are the aeroplane manufacturing and shipbuilding departments. More than half of the aeroplanes regularly used in Canada were produced in the Vickers works at Montreal, and the company has been in the forefront of aeroplane pioneering from a manufacturing standpoint in Canada for a number of years. Considerable attention is being devoted at present to experimental work for the production of purely Canadian types of aircraft and for the re-designing of existing models to meet exacting Canadian requirements. To such an extent has the company's aeroplane manufacturing business developed that the factory facilities in this branch have been doubled. The comprehensive nature of the activities is demonstrated by the fact that the company is engaged in the design and construction of land and seaplanes, flying boats, amphibians for general and special purposes, for Government operations and for commercial companies and private owners. The company also designs and develops types specially suitable for Canadian climatic and topographical conditions.

The aircraft factory is equipped for the construction of any type of aeroplane in wood or metal. This branch includes offices, stores, a designing department, drawing-offices, woodwork, metal work, engineering, fabric covering, doping, rigging, propeller making, and inspection shops. With the exception of aero-engines and instruments, the aeroplanes are entirely produced from the raw materials in this factory where 200 people are regularly employed. The floor space occupied by aircraft manufacture, including drawing-offices, is approximately 100,000 square feet. The factory was started in 1923 to meet Canadian Government demands and the needs of commercial flying in Canada. The aircraft industry had ceased to exist in the Dominion with the end of the Great War, but within a few years after the cessation of hostilities a new interest in flying sprang up, particularly from the viewpoints of civil requirements and commercial needs. The company encountered a considerable number of obstacles in its pioneer work, but they have been successfully overcome without Government grant or other assistance. As evidence of the varied requirements for flying in Canada, it may be pointed out that the company at present manufactures no less than eleven distinct types of aircraft. Both metal and wood are employed in the structure of the aeroplanes. The raw materials are brought from Britain to be fashioned into the finished product at the Montreal plant. Canadian materials are also used, particularly in the wood section. Large quantities of the finest spruce are brought from British Columbia and much mahogany is also procured for special purposes.

An interesting section of the factory is the propeller department. There, wood propellers, scientifically developed and balanced, are made by hand in nine-ply, laminated form, glued and clamped, and carefully shaped to precise dimensions with hand tools. Most interesting, too, is the department in which the wings, ailerons, elevators and rudders are manufactured. Web-like sections of fine wood gradually take shape at the hands of deft workmen. Pieces of wood are inserted and fitted here and there in succession until the skeleton of the wing or other part is completed. They are then transferred to the fabric covering department, where girls sew the cloth to the frames, the resultant whole being a smooth, graceful form. The completed structures are sent to the doping department, in which they are treated with a non-poisonous dope and in which there is a specially designed system of forced ventilation to carry off vapours during the operation.

Frames built up of steel tubing have replaced wooden frames for the cabin and fuselage in the Vickers aeroplanes because it has been found that steel frames are better suited to Canadian climatic changes, since they undergo less contraction and expansion under cold and heat. Duralumin is used in large quantities for body or cabin sections, hulls, floats, tanks, and skis, because of its lightness and strength.

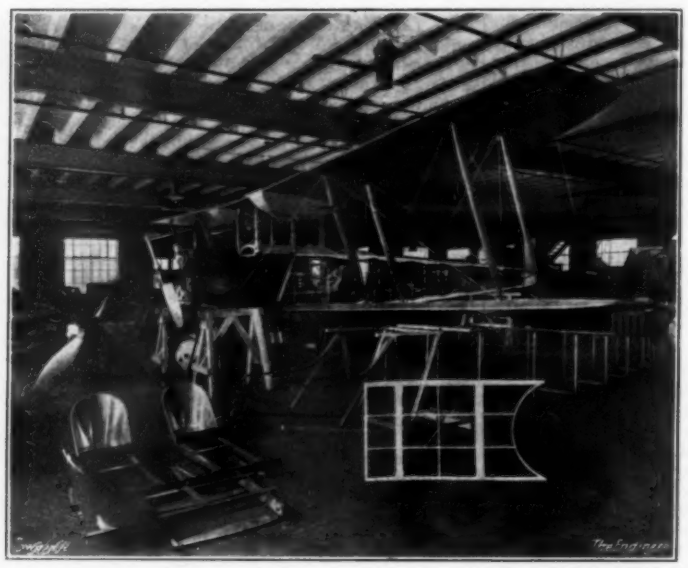
In addition to manufacturing the machines the company does extensive work in repairs, rebuilding, and remodelling. The *personnel* of the air factory includes designers, draughtsmen, craftsmen, pilots, and inspectors, in addition to artisans. A proportion of the staff is drawn from Europe and the United States, the men being specially chosen because of their personal qualifications. In one office of the factory is the Canadian Government staff of resident inspectors who pass every bit of material and construction. This is entirely apart from the company's own inspection.

A feature of the plant is the licensed Customs air harbour for flying boats. This harbour, which facilitates the arrival and departure of flying boats transporting supplies, is at present being extended to meet growing needs. Precautionary measures in the factory include an automatic sprinkler system, fire-fighting equipment and a system of fire alarms. Incidentally, there is a safety first organisation.

The extent and variety of the business carried on at these works is indicated by the fact that at one period, recently, forty-one aeroplanes, comprising nine different types, including land planes, float machines, flying boats, amphibians and experimental machines, were under construction simultaneously. They were being built for such work as air mail service in Canada, forestry, survey, fishing patrol, sea patrol, navigation investigation and transportation. Aeroplanes made at the company's plant are sent to all parts of Canada from coast to coast, including the remote regions where they are used in pioneer engineering operations.

Another notable feature among the varied industrial activities at the works is the shipbuilding department. In this connection it should be stated that the plant was established at Montreal in 1912, when the big dry dock, with a lifting capacity of 22,500 tons—large enough to accommodate the largest ships now arriving at Montreal—was taken out from England.

There are three slipways for the construction of large and small vessels. They are housed in a large building, one end of which is of sectional design, so that it can be removed for the launching of ships. Gangways for workmen are suspended from the roof. The gangway across the water end of the building is lifted when a ship is to be launched. As the building is covered, shipbuilding operations can be carried on at all times of the year, regardless of weather conditions. The ways lead out into an extensive basin, which is also large enough to accommodate the floating dry dock and also any large vessels that require repairs. The dry dock, which is in three sections, any one or all of which may be used to lift a ship,

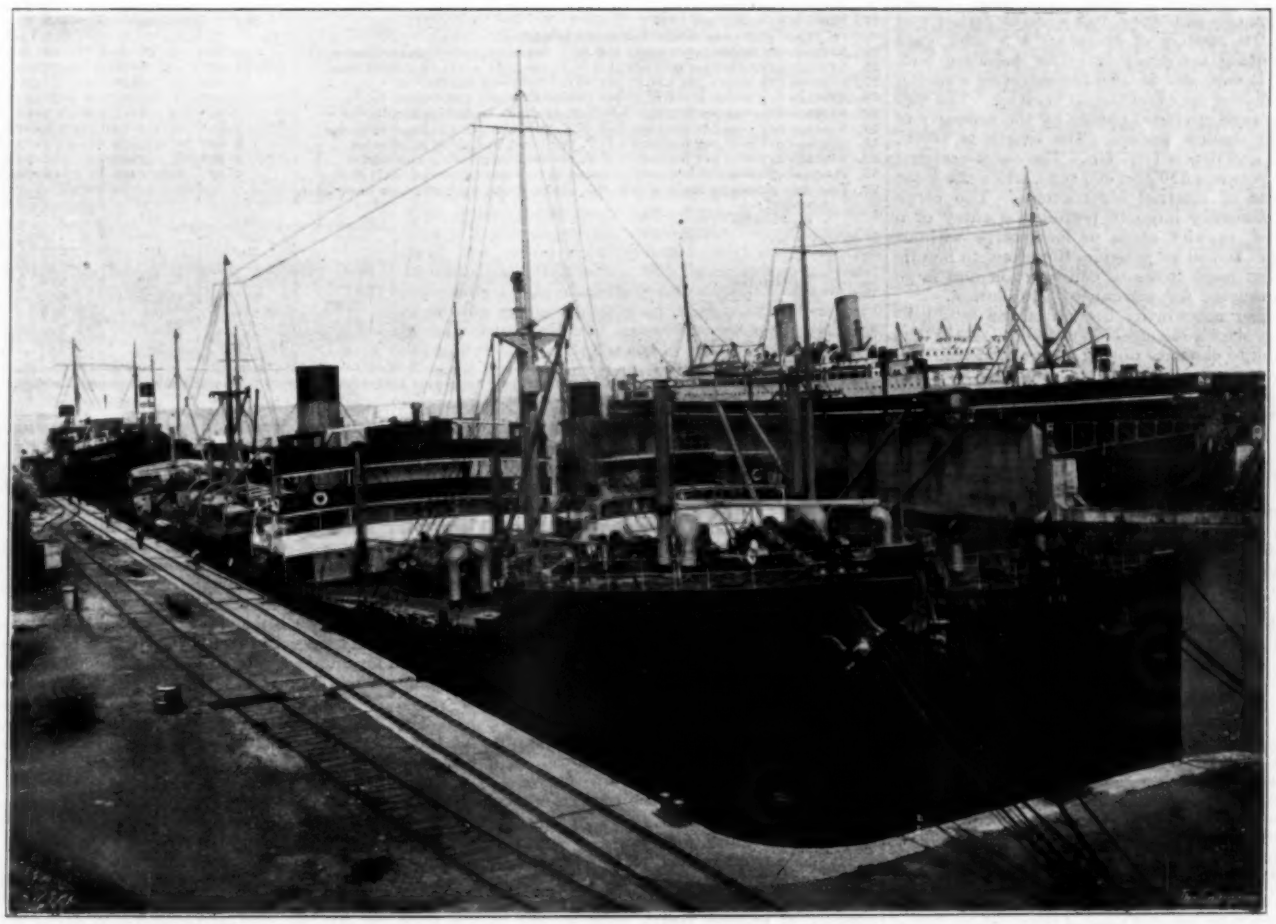


ONE OF THE AIRCRAFT SHOPS

HULL OF "VEDETTE" FLYING BOAT

THE WORKS AT MONTREAL OF CANADIAN VICKERS, LTD.

GENERAL VIEW OF THE WORKS AND DOCK



SHIPPING BASIN WITH FLOATING DOCK IN BACKGROUND

according to requirements, is in regular use throughout the season for all types of vessels and is a valuable adjunct of the enterprise. All equipment necessary for dry dock work is available, even to deep sea diving outfits.

Some interesting types of vessels are constructed. Two recent examples were the "Donnacona No. 1" and the "Donnacona No. 2," which are special pulpwood freighters for the Donnacona Paper Company, which were built at a cost of 50,000 dollars each. Another vessel recently completed was a general service motor ship built for the Foundation Company of Canada, Ltd. This craft, which is of special type, was—largely the inspiration of Mr. R. E. Chadwick, vice-president and general manager of the Foundation Company—especially strengthened at the forward end for operation in ice. It will be employed principally as a work vessel in the Gulf of St. Lawrence, where its efficient salvage equipment will also be available in any emergency. The Kromhout two-cycle oil engine was adopted as its prime mover. A fuel storage capacity to give the ship three months of continuous operation and six months under normal conditions has been provided, and it will enable the vessel to remain in an ice-bound locality for the whole winter. It will operate as a floating power plant for the supply of electric current and compressed air for shore operations. The two main engines, which are 200 B.H.P., drive twin propellers, which give the ship a speed of between 8 and 9 knots, while English Electric Company 170 kVA, three-phase, 60-cycle, 550-volt alternators, having direct connected exciters, provide for the transmission of electricity for salvage or construction work. Current is supplied for the operation of an Ingersoll-Rand motor-driven compressor of 500 cubic feet capacity for air tool service and for divers. The alternators also operate the main

A WOOD PULP DIGESTER

derrick and its swinging engine. The main derrick, which is arranged amidships, has a lifting capacity of 50 tons and is capable of operating a 2 cubic yard clamshell bucket for dredging or for handling bulk materials. It may also be used for operating a special ram over the bow for breaking up pack ice. The hull proportions were governed chiefly by the necessity of operating in shallow waters. The length is 140ft., beam 35ft., and depth 11ft. 6in. The cargo-carrying capacity is between 350 and 400 tons, while the main hold is clear of internal obstructions. The cargo hatch is sufficiently large to permit the entry of a steam shovel, crawler crane or locomotive without dismantling. It will be possible, therefore, to handle and transport large items of construction and large machines intended for permanent installation.

Still another noteworthy branch of the establishment is the structural steel department, which has been working to capacity during recent months. The steel work, in beams, web trusses and other forms, is employed for the construction of office buildings, industrial plants, bridges, sluice gates, &c. General engineering requirements are also filled, such as the equipment for pulp and paper mills, hydro-electric plants, mines, oil tanks, hoists, digesters, &c. The steel work for the power-house at Chelsea, of the International Paper Company, was supplied and erected by the company, which employs, all told, approximately 1400 men, and which, because of diversification of its operations, has been uniformly busy. Affiliated with the company is the St. John Dry Dock and Shipbuilding Company, Ltd., at St. John, New Brunswick, where there are dry docks, a marine slipway, tugs, a floating repair plant, and other facilities for extensive operations.

THE Swiss Federal Railways are now preparing for the beginning of the second electrification scheme, in connection with which it has been calculated that 1,800,000 francs will be necessary for enlarging the tunnels on the old line Jura-Neuchâtel, while 1,400,000 francs will be needed to strengthen or replace the iron viaducts which will be called upon to bear the extra weight of the heavy electric locomotives on the Jura-Bern lines. The near future will also see put in hand certain work which had to be left in abeyance during the electrification. On certain sections double lines will be installed; one of them will be that of Flamatt-Thoerishaus, and a credit of about five millions francs will be voted to this end.

New York Central—Express Passenger Locomotives.

By E. C. POULTNEY, O.B.E.

No. III. (*conclusion*).*

LOCOMOTIVE TESTS.

SHORTLY after engine No. 5200 had been delivered to the railway company in February, 1927, it was turned over to the testing department in order that a complete series of trial runs might be made to test the capabilities of the design before the further locomotives required were built.

All the trials were conducted during the months of March to June inclusive, the various trips being made over the Mohawk Division of the New York Central main line between New York and Buffalo. This particular section comprises 140 miles of road commencing at a point 141·52 miles from New York Grand Central Terminal East 42-street, and 1·43 miles east of Albany, N.Y., and extending to the 282nd mile post, which is 0·43 miles to the west of Minoa and 8·65 miles eastward of Syracuse, N.Y.

The principal trials were run with trains made up of twenty and twenty-six coaches, including in each case, the dynamometer car, and were carried out between Rensselaer, N.Y., 142·37 miles, and Minoa, N.Y., 282·43 miles from New York.

This is a high-class length of track laid with heavy section rails weighing from 100 lb. to 127 lb. per yard, is well timbered and stone ballasted.

Travelling both eastbound or westbound, the gradients are for the most part very favourable, with the single exception of an exceptionally severe, though comparatively short, rise travelling east, between Albany and West Albany, 3·09 miles, between which the gradients are from 51ft. to as much as 86ft. per mile, the greater part being, however, at 81ft. per mile, or 1 in 65. Having once overcome this steep rise the locomotives have a splendid run right through to Minoa and on to Syracuse. Over this distance the line rises and falls by easy gradients, varying for the most part between about 5ft. to about 10ft. to the mile, with some rather steeper short lengths of from 17ft. to 19ft. per mile, or 1 in 310 to 1 in 277. Interspersed between these undulations there are numerous lengths of level, or practically level stretches. The elevation at West Albany is 185·4ft., and at Minoa, the eastern extremity of the Mohawk Division, it is 407·4, making a total rise in the 136·42 miles of 222ft.

The road trials made over the distance of 140 miles were conducted in order to determine the performance of the locomotive when working very heavy trains running at express speed, with a view of not only ascertaining the mean and maximum power output, but also to furnish complete data as to working efficiency.

During each run records were made to establish:—

(*a*) The mean indicated and draw bar horse-powers.

(*b*) The mean coal and water rates per I.H.P. and per D.B.H.P. hour.

(*c*) The efficiency of the steam generation, including the boiler superheater and feed-water heater.

(*d*) The machine efficiency of the locomotive.

(*e*) The thermal efficiency of the locomotive as measured at the tender draw bar and based on the heat in the fuel fired.

For the purpose of furnishing data which might be of value as showing what advantage the use of the limited cut-off system might have for high-speed locomotives, a complete series of all the tests was made with the maximum cut-off reduced from 84 to 65 per cent., and with the boiler pressure increased from the standard 225 lb. to 250 lb. per square inch, in order to preserve closely the nominal rated tractive effort of 42,300 lb. obtained with the former working pressure. To permit of this comparison being made, certain details in the valve motion were changed, and also the valves and bushings, so that efficient steam distribution could be had when the maximum cut-off was reduced from 84 to 65 per cent.

RUNNING CONDITIONS.

During all test runs the locomotive was operated with the throttle or regulator valve wide open, and the whole of the coal fired was handled by the Duplex mechanical stoker, and the boiler feed was entirely supplied by the Elesco feed heater and Duplex C.F. type pump.

The trains for all the 140-mile division runs were composed of modern "all-steel" standard cars, and, in addition, the dynamometer car.

The weights for the heaviest test trains were:—For twenty-five cars and one dynamometer car, 1863 tons (2000 lb.), or 1660 tons (2240 lb.); and with engine and tender, 2140 tons (2000 lb.), or 1907 tons (2240 lb.); for nineteen cars and one dynamometer car, 1428 tons (2000 lb.), or 1280 tons (2240 lb.); and with engine and tender, 1705 tons (2000 lb.), or 1527 tons (2240 lb.) The locomotive weight is taken as 555,200 lb., or 277·6 short, or 247·8 long tons, and is the total weight in full working order with the eight-wheeled tender.

THE TEST RESULTS.

In order to show the working results obtained with the locomotive over the division runs of 140 miles each, the statements given in Tables VI., VII. and VIII. have been prepared. The information has been obtained from the official tabulated results drawn up by the Test Department of the railway, which contain additional information. The data, however, now given are sufficient to indicate the locomotive

TABLE VI.—*Performance Tests Under Actual Road Operating Conditions.—Particulars of Recorded Data.*

Number of cars	26	26	20	20
Weight of cars, tons (2000 lb.)	1,863	1,696	1,428	1,421
Mean speed, m.p.h.	44·2	43·71	48·14	48·52
Maximum cut-off, per cent.	65	84	65	84
Power:				
1. Average sustained indicated horse-power	2,545	2,420	2,582	2,482
2. Average draw bar horse-power (5 min. readings)	1,982	1,873	1,803	1,834
3. Average frictional horse-power	337	318*	385	342*
4. Average of maximum tractive effort based on maximum M.E.P.	41,251	37,060	37,897	34,978
5. Average mechanical efficiency of locomotive, 2 ÷ 1 × 100	77·8	77·0	72·0	73·5
6. Average machine efficiency	87·3	87·9	85·4	87·1
Boiler Performances:				
7. Average dry coal fired per hour, lb.	5,326	5,527	5,499	5,238
8. Average coal as fired per square foot of grate per hour, lb.	67·6	69·2	70·0	65·7
9. Average dry coal fired per square foot of grate per hour, lb.	65·3	67·8	67·4	64·3
10. Average calorific value of dry coal, B.Th.U. per lb.	13,611	13,388	13,501	13,368
11. Water delivered to boiler, average lb. per hour	43,720	43,916	43,276	42,621
12. Percentage of average total water evaporated delivered to cylinders	90·81	89·81	90·43	90·24
13. Average equivalent evaporation at header, boiler, superheater and feed-water heater (combined), lb. per hour	58,672	59,552	58,037	57,371
14. Total water evaporated per square foot combined heating surface per hour, lb.	6·8	6·9	6·73	6·62
15. Total water per lb. dry coal	8·21	7·97	7·89	8·15
16. Average boiler efficiency at header, including superheater and feed-water heater, per cent.	78·6	78·3	76·2	79·6
17. Average boiler efficiency at steam chest, including superheater and feed-water heater, per cent.	72·1	71·4	69·9	72·6
Steam Pressures and Temperatures:				
18. Average boiler pressure gauge at dome, lb. per sq. in.	243	219	243	219
19. Average steam chest pressure gauge, lb. per sq. in.	231	204	231	210
20. Average exhaust pressure gauge, lb. per sq. in.	5·3	5·6	5·2	5·4
21. Average superheat at header, deg. Fah. (total steam temperature)	669	669	671	666
Engine Running Conditions:				
22. Speed, m.p.h., while working engines	44·25	43·71	48·14	48·52
23. Average cut-off, per cent.	32·7	38·2	30·5	31·5
24. Throttle opening, per cent.	100	100	100	100
Coal Rates and Steam Rates and Efficiency:				
25. Average dry steam per average D.B.H.P. per hour, including auxiliaries	23·77*	24·90	24·62*	24·64
26. Average dry steam per average D.B.H.P. per hour, excluding auxiliaries	21·53*	22·36	22·18*	22·23
27. Average dry steam per I.H.P. per hour, including auxiliaries	17·14*	18·16	16·84*	17·21
28. Average dry steam per I.H.P. per hour, excluding auxiliaries	15·50*	16·31	15·17*	15·52
29. Average dry coal per average D.B.H.P. per hour, including auxiliaries	2·90*	3·13	3·12	3·04*
30. Average dry coal per average D.B.H.P. per hour, excluding auxiliaries	2·62*	2·83	2·81	2·74*
31. Average dry coal per average I.H.P. per hour, including auxiliaries	2·09*	2·28	2·14	2·12*
32. Average dry coal per average I.H.P. per hour, excluding auxiliaries	1·89*	2·07	1·92	1·91*
33. Thermal efficiency of locomotive based on fuel and referred to D.B.H.P.	6·46	6·09	6·06	6·32
34. Test run numbers from which the above mean performances have been compiled:—				
Westbound	203	101	211	107
	207	103	213	109
	209	105	215	111
			221	113
Eastbound	206	102	214	108
	208	106	216	114
	210		218	
			220	
			224	

NOTE.—All minimum figures marked * represent better performance than maximum numerical result.

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* No. II. appeared November 23rd.

performance, and the particulars have been separated under different headings, relating to the power output, boiler performance, steam conditions, engine running conditions, and finally, the coal and steam consumptions, on the basis of the mean cylinder and draw bar horse-powers are given, and also the mean overall or locomotive efficiencies.

TABLE VII.—*Maximum Average Results Obtained for Each Item During Any One 140 Mile Run.*

Particulars of Recorded Data.		
Number of cars	26	26
Weight of cars, tons (2000 lb.)	1,863	1,696
Mean speed	54·55	55·49
Maximum cut-off	65%	84%
Power.		
1. Average sustained indicated horse-power	2,986	2,803
2. Average draw bar horse-power (5 min. readings)	2,240	2,210
3. Average frictional horse-power	453	430
4. Average of maximum tractive effort based on M.E.P.	44,415	44,016
5. Average mechanical efficiency, 2 ÷ 1 × 100	75·5	78·6
6. Average machine efficiency	90·2	88·9
Boiler Performance.		
7. Average dry coal fired per hour, lb.	4,871	4,970
8. Average coal as fired per sq. ft. of grate per hour, lb.	61·8*	62·3
9. Average dry coal fired per sq. ft. of grate per hour, lb.	59·8	61·0
10. Average calorific value of dry coal B.Th.U. per lb.	13,891	13,723
11. Water delivered to boiler, average, lb. per hour	47,253	48,631
12. Percentage of actual water evaporated delivered to cylinders	92	91·66
13. Average equivalent evaporation at header boiler superheater and feed-water heater (comb.), lb. per hour	63,387	66,194
14. Total water evaporated per sq. ft. of comb. heating surface per hour, lb.	7·36	7·55
15. Total water per lb. dry coal, lb.	8·76	8·62
16. Average boiler efficiency at header, including superheater and feed-water heater	84·2	84·5
Steam Pressures and Temperatures.		
17. Average boiler pressure gauge at dome, lb. per sq. in.	245	221
18. Average steam chest pressure gauge, lb. per sq. in.	234	214
19. Average exhaust pressure gauge, lb. per sq. in.	6·4	6·5
20. Average superheat at header, total steam temperature, deg. Fah.	685	692
Engine Running Conditions.		
21. Speed, m.p.h., while working engines	54·55	55·49
22. Average cut-off, per cent.	27·7*	29·3
23. Throttle opening, per cent.	100	100
Coal and Steam Rates and Efficiency.		
24. Average dry steam per average D.B.H.P. per hour, including auxiliaries, lb.	22·67*	23·53
25. Average dry steam per average D.B.H.P. per hour, excluding auxiliaries, lb.	20·34*	21·16
26. Average dry steam per I.H.P. per hour, including auxiliaries, lb.	15·04*	16·29
27. Average dry steam per I.H.P. per hour, excluding auxiliaries, lb.	13·58*	14·72
28. Average dry coal per D.B.H.P. per hour, including auxiliaries, lb.	2·68*	2·76
29. Average dry coal per D.B.H.P. per hour, excluding auxiliaries, lb.	2·41*	2·48
30. Average dry coal per I.H.P. per hour, including auxiliaries, lb.	1·89*	1·93
31. Average dry coal per I.H.P. per hour, excluding auxiliaries, lb.	1·70*	1·77
32. Thermal efficiency of locomotive based on fuel and referred to D.B.H.P., per cent.	6·9	6·9

NOTE.—Except where noted *, the minimum figure represents the best results.

TABLE VIII.—*Capacity Tests.—Particulars of Recorded Data.*

Number of cars	26	26
Weight of cars, long tons	1,660	1,510
Maximum cut-off, per cent.	65	84
Maximum D.B.H.P.	3,760	3,490
Speed, m.p.h.	60·0	57·5
Cut-off, per cent.	52·0	49·0
Throttle opening, per cent.	100	100
Maximum I.H.P.	4,295	4,073
Speed, m.p.h.	66·7	65·7
Cut-off, per cent.	52·0	49·0
Throttle opening, per cent.	100	100
Maximum tractive effort exerted when starting from rest without booster	47,500	46,500
With booster	57,500	56,500
Maximum rate of water delivered to boiler, lb. per hour.	—	70,000

The performance of the locomotive under actual road-operating conditions, is shown by Table VI., from which it will be noted that the mean speeds attained varied between 43·71 and 48·52 miles per hour, and that the actual amount of water delivered to the boiler per hour, based on the actual working time, that is, when the throttle was open, was from 42,621 lb. to 43,916 lb. The total combined heating surface is 6435 square feet, under such conditions the actual evaporation per square foot of heating surface is shown to be from 6·62 lb. to 6·9 lb. per hour; average sustained powers ranging between 2420 and 2582 I.H.P. show the high capacity of this engine, and the steam and coal rates of 23·77 lb. and 24·9 lb., and 2·9 lb. and 3·13 lb. respectively per D.B.H.P. hour, including the consumption chargeable to the auxiliaries may be considered excellent.

Confining attention to the performance with the twenty-six car train, the maximum average powers are 2545 I.H.P. obtained with the limited cut-off arrangement, and 2420 I.H.P. with the normal valve setting, giving an 84 per cent. cut-off in full gear. The coal and steam rates both on the basis of draw bar and cylinder powers are remarkable, and for the limited cut-off arrangement, which throughout all the tests gives rather the better results, the coal per D.B.H.P. hour, including auxiliaries, is 2·9 lb. and without 2·62 lb. On the I.H.P. basis these figures are 1·89 lb. and 1·46 lb.

Turning now to the steam rates, these are as follows:—23·77 lb. and 21·53 lb. per D.B.H.P. hour, with and without the auxiliaries, and 17·14 lb. and 15·5 lb. per I.H.P. hour without auxiliary equipment, and for cylinder feed only. The latter figures are excellent, the more so when it is remembered that they are the average results obtained from a number of road tests under general operating conditions.

The performance of the boiler, superheater and feed heater is seen when examining the figures for the evaporation, coal rate, and superheat, and certain additional information concerning the draught readings is given by the following statement, covering the performance with both the twenty-six and twenty car trains, and each of the cut-off conditions.

Draught Readings, Exhaust Pressure, and Firing Rates.

	Twenty-six car train.		Twenty car train.	
Cut-off (max.), per cent.	65	84	65	84
Average exhaust pressure, lb. per sq. in.	5·3	5·6	5·2	5·4
Average draught front of diaphragm	6·1	6·2	6·0	6·0
Average draught back of diaphragm	4·1	4·3	3·9	4·2
Average draught in fire-box	1·6	1·4	1·4	1·4
Average draught in ash-pan	0·2	0·3	0·3	0·3
Average dry coal fired per hour, lb.	5326	5527	5499	5238
Average dry coal fired per sq. ft. of grate per hour, lb.	65·3	67·8	67·4	64·3

Draught readings in inches of water.

The draught shown in the ashpan indicates adequate damper openings, and the relative readings in the fire-box and at the smoke-box tube plate, at the back of the diaphragm, seems very good when it is remembered that the tubes and flues are 20ft. 6in. long. Turning to the evaporations, it will be seen that when operating the twenty-six car train and with the 84 per cent. maximum cut-off arrangement, the equivalent average evaporation reached is 59,553 lb. per hour, and that, based on the coal as fired, the water coal ratio is 7·8 and on the dry coal ratio it is 7·97. The steam plant efficiency—that is, the boiler, superheater, and feed heater—is 78·3 per cent. based on the heat output at the superheated steam side of the header. For all the tests shown in Table VI. the mean temperature of the superheated steam is from 666 deg. to 671 deg. Fah. and the pressure drop is between 12 lb. and 19 lb.; with steam at the total temperatures given the superheat added by the Type E superheater averages from 266 deg. to 268 deg. Fah. for the 65 per cent. cut-off arrangement, and the higher boiler working pressure of 250 lb., and for the 84 per cent. maximum cut-off and 225 lb. boiler working pressure conditions the mean superheat is about 271 deg. to 274 deg. No doubt the low steam rates with the rather long average cut-offs employed are due to the high average temperatures of the steam supplied to the engines.

Referring to the mean performance of the engine when working the twenty-car train, it will be noted that with the 65 per cent. maximum cut-off arrangement the steam rate, cylinder feed only, is but 15·17 lb. per I.H.P. hour. This figure, it is considered, represents a low mean steam consumption for a simple expansion engine under road service conditions, and it may therefore be of interest to see what cylinder efficiency is shown. The steam pressure at the steam chests is 231 lb. and the total temperature measured at the header is 671 deg. Fah. On the assumption that this temperature is maintained at the steam chests, then the heat content of each pound of steam as supplied to the cylinders will be 1357 B.Th.U.* The thermal equivalent of 1 horse-power hour is $\frac{33{,}000}{778} \times 60 = 2545$ B.Th.U.; therefore the mean working efficiency of the cylinders based on the total heat in the steam will be $\frac{2545}{1357} \times 1517 \times 100 = 12{\cdot}4$ per cent. Actually the efficiency will be rather better, because from the data furnished relative to the steam plant efficiency, that of the boiler, superheater and feed-water heater combined, it will be seen that, measured at the header, the efficiency is 72·6 per cent., whilst at the steam chest it is 69·9 per cent., representing a heat loss between these points of 3 per cent. This loss in the heat carried per pound of steam between the header and steam chests will increase the cylinder efficiency to 12·8 per cent., owing to the lower heat content in the steam as actually supplied to the cylinders for a given power output.

The figures appertaining to the machine friction of the engines are 337 and 318 horse-power for the twenty-six-car trains, representing average mechanical efficiencies of 87·3 and 87·9 per cent. The somewhat long cut-offs employed will to some extent be responsible for these very satisfactory values. It may here be added that the machine frictional horse-powers given are obtained by deducting from the difference between the cylinder and draw-bar powers the power absorbed by head air, gradient and track resistances. Each observation of draw-bar pull was corrected for gradient curve and head air resistances, the frictional horse-power being then corrected for rolling resistances of the engine truck, trailer and tender.

The results given in the table are the averages for all data obtained during several representative runs made over an entire division of 140 miles, and it should be pointed out that certain of the figures appertaining to the coal and steam rates represent better performances than the maximum average results obtained on individual runs.

Referring now to Table VII., which shows the maximum average pe formance obtained for each of the several items during any one test run over the 140 miles, and except where noted the minimum figures represent the best result. This refers to the coal and steam consumptions.

All the runs from which these particulars are compiled are those made with twenty-six cars, the mean speeds whilst working the engine ranging from 54·55 to 55·49 miles per hour. The average powers are high, being for the 65 per cent. maximum cut-off conditions 2986 I.H.P., and for the 84 per cent. maximum cut-off arrangement 2803 I.H.P., whilst the maximum average draw-bar horse-powers maintained are 2240 and 2210 respectively. The highest actual mean rates of evaporation are 47,253 lb. and 48,631 lb. of water per hour, and per square foot of the combined heating surfaces 7·36 lb. and 7·56 lb. Likewise the maximum mean sustained rates of equivalent evaporation range from 63,387 lb. to 66,194 lb., calculated on the steam conditions at the superheater header and including the feed heating equipment. The maximum average steam temperatures are 685 deg. and 692 deg. Fah., and the highest mean boiler presaures maintained are 245 lb. and 221 lb., and the best mean boiler efficiencies including the superheater and feed heating equipment, reach the high figures of 84·2 and 84·5 per cent.

A summary of the highest sustained powers obtained, together with the conditions governing such, as speeds and cut-offs, are given in Table VIII. The results are shown for both the limited and normal cut-off arrangements. The maximum cylinder horse-power developed was obtained with the valves set for the restricted cut-off of 65 per cent. and with the boiler pressed to 250 lb. Under these conditions at 60 miles per hour and with a 52 per cent. cut-off 4295 I.H.P. was obtained. This is equal to 1·5 square feet of combined heating surface per I.H.P. and 52·7 I.H.P. per square foot of grate area, and gives an engine weight of only 80 lb. per I.H.P. The maximum evaporation reached is 70,000 lb. of water per hour, equal to 10·9 lb. per square foot of combined heating surface.

Figs. 11 and 12 show the traction and draw-bar horse-power curves as developed from the capacity tests for the normal and limited cut-off arrangements respectively, and the cut-offs required at the various speeds between zero and 70 miles per hour. An excellent idea is thus obtained of the enormous sustained power which these locomotives can develop. It will be seen that with the full stroke cut-off arrangement the maximum draw-bar horse-power is 3490 at about 57·5 miles per hour, when the pull is 22,500 lb., or just over 10 tons, whilst at 70 miles per hour the draw-bar pull is about 15,600 lb., or 7 long tons.

Similarly, for the limited cut-off conditions the highest draw-bar horse-power is 3760 at 60 miles per hour when the pull is 23,500 lb., equal to 10·5 tons, and at 70 miles per hour the pull on the draw-bar is remarkable, being about 19,500 lb., or 8·7 tons. The cut-offs possible at high speeds, which are 52 and 46 per cent. at 65 to 70 and 70 to 75 miles per hour for the limited cut-off arrangement, are in themselves adequate evidence of the very high steaming capacity of the boiler plant.

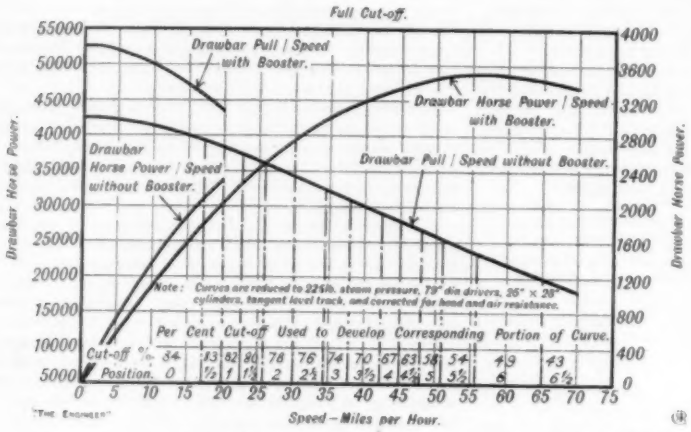
The acceleration tests were all made over the same section of track, commencing at mile post 162·2 miles west of Schenectady. The results are shown by Table IX, which is divided into two parts. Section 1 gives the distance in feet run by each train before attaining certain definite speeds in miles per hour, both with and without the booster, and Section 2 shows the time taken to reach a given speed, with and without the booster.

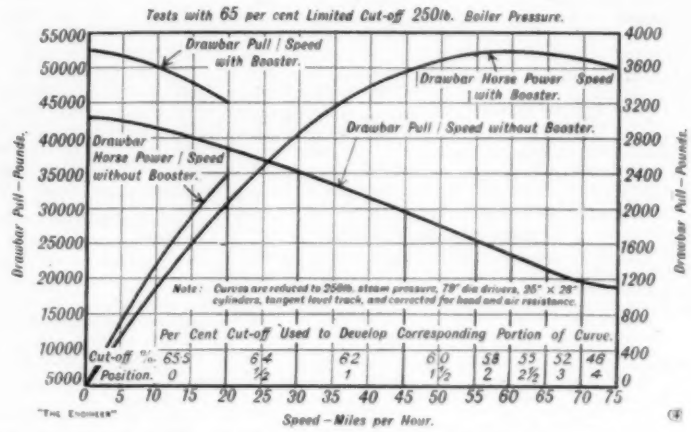
As for all other trials the locomotive was operated with the valves set for a maximum cut-off of 84 per cent., and for a limited cut-off of 65 per cent. For both cut-off conditions the trains were made up to as nearly as possible the same weight behind the tender. Each car was a standard all-steel coach, running on six-wheeled trucks, there being twenty-five and twenty in each train respectively, and, in addition, the dynamometer car. The train weights are expressed in short tons, the equivalent tonnage being 1667 and 1675 long tons for the twenty-six-vehicle trains, and 1345 and 1350 long tons for those having twenty cars. The road rises slightly for most of the distance, the gradient being at the rate of 0·13 per cent., or 1 in 777.

The figures are interesting, as showing how the booster assists in getting up speed, and at the same time that as the desired speed becomes greater, the

* *Mechanical Engineering*, Feb., 1927. "Progress Report on the Development of Steam Charts and Tables, Harvard Throttling Experiments," J. H. Keenan.

less be omes the influence of the booster ; or, in other words, if the desired speed is low, say, 10 miles per hour, then, taking the twenty-one-car train, the distance travelled when the booster is in use is 85 per cent. of that required without the booster, whilst if the required speed is 30 miles per hour, then with the booster the distance to be traversed is increased to nearly 93 per cent. of that required without. In the same manner, while the time taken to attain 10 miles per hour is 45 per cent. longer without the booster, it is only 10 per cent. longer if the desired speed to be attained is increased to 45 miles per hour.


Full Cut-off.
Drawbar Pull / Speed with Booster.
Drawbar Horse Power / Speed with Booster.
Drawbar Horse Power / Speed without Booster.
Drawbar Pull / Speed without Booster.
Note: Curves are reduced to 225lb. steam pressure, 79" dia drivers, 26" × 28" cylinders, tangent level track, and corrected for head and air resistance.
Per Cent Cut-off Used to Develop Corresponding Portion of Curve.
Cut-off %
Position.
Drawbar Horse Power.
Drawbar Pull – Pounds.
Speed – Miles per Hour.


Tests with 65 per cent Limited Cut-off 250lb. Boiler Pressure.
Drawbar Pull / Speed with Booster.
Drawbar Horse Power Speed with Booster.
Drawbar Pull / Speed without Booster.
Drawbar Horse Power / Speed without Booster.
Note: Curves are reduced to 250lb. steam pressure, 79" dia drivers, 26" × 28" cylinders, tangent level track, and corrected for head and air resistance.
Per Cent Cut-off Used to Develop Corresponding Portion of Curve.
Cut-off %
Position.
Drawbar Pull – Pounds.
Speed – Miles per Hour.

FIGS. 11 AND 12—DRAW-BAR HORSE-POWERS AT DIFFERENT SPEEDS WITH FULL AND 65 PER CENT. CUT-OFFS

TABLE IX.—*Acceleration Tests, Showing also the Influence of the Booster.*

Section 1:				
Train, number of cars	26	—	21	—
Train weight (cars only)	1,863	1,877	1,504	1,510
Maximum cut-off (full gear)	65%	84%	65%	84%
	Distance in feet.			
At 10 m.p.h. without booster	603	635	463	491
At 10 m.p.h. with booster	400	503	396	400
At 20 m.p.h. without booster	2,598	2,665	1,663	1,919
At 20 m.p.h. with booster	1,868	2,115	1,481	1,913
At 30 m.p.h. without booster	6,794	—	4,784	4,988
At 30 m.p.h. with booster	5,480	—	4,484	4,595
At 45 m.p.h. without booster	—	—	13 810	14,960
At 45 m.p.h. with booster	—	—	13,954	13,960
Section 2:	Time in minutes and seconds.			
At 10 m.p.h. without booster	1 23	1 21	1 3	1 11
At 10 m.p.h. with booster	0 55	1 2	0 49	0 49
At 20 m.p.h. without booster	2 53	2 48	2 5	2 2
At 20 m.p.h. with booster	2 2	2 10	1 40	1 42
At 30 m.p.h. without booster	4 47	—	3 23	3 23
At 30 m.p.h. with booster	2 40	—	2 57	2 59
At 45 m.p.h. without booster	—	—	6 4	6 20
At 45 m.p.h. with booster	—	—	5 46	5 44

Time calibration trials were carried out between Albany, N.Y., and Schenectady, N.Y., the total distan e being 16·9 miles. This length of road includes the Albany gradient, part of the distance being on a rising gradient of 86ft. per mile, and on this there is a reverse curve of 25 and 14·8 chains radius.

Starting from Albany westbound, the first 1000ft. are practically level, but numerous points and crossings prohibit the use of sand to prevent the driving wheels from slipping. Further than that, the speed is limited to 10 miles per hour, so that it will be appreciated that there is no opportunity to get up speed before entering upon the heavy ascent already mentioned. The times taken from starting from Albany to stopping at Schenectady, are set out in Table X , and the passing times at two intermediate points are also included.

The test trains were substantially of equal weight, the tonnage behind the tender being 1130 and 1048 tons (2000 lb.), and 1010 and 938 tons (2240 lb.).

As for all other tests, the data for full stroke and " limited cut-off " conditions is given.

TABLE X.—*Time Calibration Tests, Albany to Schenectady, Start and Stop.*

Train, number of cars	14	14	13	13
Train, composition	13 Pullman sleepers, 1 dyn. car		12 Pullman sleepers, 1 dyn. car	
Train weight (cars only)	1130	1130	1048	1048
Maximum cut-off (full gear)	65%	84%	65%	84%

Station.	Dist'ce.	Time in min. and sec.							
Albany	—	—	—	—	—	—	—	—	—
W. Albany	3·07	12	12	14	0	9	3	9	22
Karner	8·1	19	30	21	40	15	32	16	25
Schenectady	16·9	29	0	31	40	24	30	25	41

The weight given are tons (2000 lb.).

It is thought that the foregoing description of these high-powered express engines may be of interest, as showing the design considered suitable to meet what are perhaps the most exacting and most severe, in so far as the conducting of fast passenger service is concerned. The tests of the first locomotive indicate not only the high-sustained powers obtained, and the efficiency with which they have been realised, but also the searching character of the investigations made in order to establish precisely the results to be expected. Further, the brief historical survey brings out, broadly it is admitted, the development of high-powered express locomotives, which has taken place on the New York Central during twenty years of progressive designing. When the maximum effective power available with the engine of 1907, which is 1760 as against 3760 for the giants of 1927, is compared, and when it is seen that as against 2·37 square feet of heating surface per D.B.H.P. needed then, now but 1·71 square feet is required, some idea is gained of the results accruing from the refinements embodied in re ent construction.

The Institute of Fuel.

No. II. (*Conclusion*).*

THE annual two-day Conference of the Institute of Fuel which was held at the Institution of Electrical Engineers on Wednesday and Thursday, November 21st and 22nd—we gave a short account of the presidential address by Lord Melchett in our last issue—was not so well attended as had been hoped, but the standard of the papers and discussions was well maintained, and they covered a very wide field.

Following the presidential address on Wednesday, November 21st, was a short paper by Sir Henry Fowler, K.B.E., chief mechanical engineer to the London, Midland and Scottish Railway, which dealt with fuel conservation in locomotive practice, in which the general features and problems of steam raising under locomotive conditions were outlined. Speaking of the efforts recently made to use steam in turbines on locomotives, Sir Henry pointed out that the exhaust cannot be used for drawing air through the fire, and therefore other auxiliary machinery must be introduced for that purpose. Difficulty was also met in transmitting the high speed of the prime mover, necessary for economy, to the comparatively slow revolution of the driving wheel—250 r.p.m. with a 6ft. 9in. driving wheel at 60 miles per hour. The adoption of electrical transmission was fascinating, and although not so efficient as other methods, was, said Sir Henry, satisfactory. There, however, he added, we came across another difficulty. Efficiency in mechanism ceased to be efficient when it was not accompanied by economy. An express locomotive did not usually run more than 45,000 miles per annum. Without being constantly used on heavy trains, it would not burn more than 750 tons of coal per annum. Assume that a saving in coal as high as 20 per cent. could be made by electrical transmission, that means 150 tons of coal. Against that must be set the interest, depreciation and extra maintenance on, and of any extra complication incurred to obtain, that saving. The ordinary steam locomotive, on the other hand, was a simple machine, and by no means costly, and the extra expense of increased machinery, transmission, &c., might easily more than swallow up quite a high saving produced by increased efficiency. There were, however, it was added, cases in which special demands justified the additional expenses. Water-tube boilers for locomotive purposes were still in the experimental stage, but seemed to open a fresh road for fuel conservation. One point which had to be considered in connection with them was the water. Not only was the consumption of fuel per square foot of grate area high, but the water evaporated as compared with the total water in a boiler was high, and water of the most suitable quality was not always available. Special arrangements had therefore to be made to prevent trouble, owing to the presence of scale. In spite of that, however, considerable progress was being made in experimental work with pressures in the neighbourhood of 1000 lb. per square inch. Recently, an attempt had been made on the Continent to use feed water heaters of various types, and certain experiments had also been made to pre-heat the air used in the fire.

Speaking of the use of pulverised fuel, Sir Henry Fowler said that owing to the difficulties of using that fuel in the confined space of a locomotive fire-box, experiments in this country had been discontinued, but, quite recently, at least two schemes had been developed in Germany to overcome those difficulties.

The most important contribution to the discussion —which, like the paper, was short—was a written communication from Dr. Oskar Taussig, Director of the Austrian Federal Railways, which went into some detail concerning the efforts being made by Austrian railway engineers in the directions indicated in the paper. The standard practice, he said, was hand firing, but tests with pulverised fuel were being arranged. On hand-fired boilers good results had lately been obtained from the Langer apparatus, which consisted of a system of steam jets inside the fire-box and a " draught averager " in the smoke-box. Very keen interest was being taken in the use of pulverised fuel in Austria, and it was pointed out that a successful development of that system would lead to a complete change in the coal policy of the Austrian railway administration. The hope was that Austrian brown coal might be treated in the manner described by Professor Fleissner in a paper before the World Fuel Conference this year. The steam pressure in use on the Austrian railways was generally 225 lb. to 250 lb., but trial trips will shortly be made with the 900 lb. Winterthur locomotive, which will be run for several months in order to get definite practical working figures. In the meantime, a 1500 lb. pressure locomotive is being built on the system devised by Professor Löffler. Notwithstanding all that, however, Dr. Taussig expressed the opinion that pressures of 225 lb. to 270 lb. will be used for a considerable time. Some Austrian locomotives have been designed with a double-seated valve gear, partly on the lines of the Lentz gear and partly on the Caprotti system, and the results are said to have been very satisfactory in comparison with the steam consumption of the older slide and piston valves. The efforts of the Austrian railway engineers in recent years in the directions indicated above, and in regard to other matters of detail, resulted in the coal consumption being reduced by more than 24 per cent. per million ton-miles, and, moreover, in carrying 20 per cent. more weight for a reduction of 8 per cent. in the total coal consumed.

Dr. T. Barratt regretted that experiments with pulverised fuel for locomotives had been discontinued, and hoped the railway companies in this country would still encourage experiments in that direction.

Mr. Fellowes Brown expressed the view that the fuel *par excellence* for English railway work was coal, and asked Sir Henry Fowler whether he would consider an expenditure of about £1000 per locomotive to be justified for installing the new valve gear, which he believed Messrs. Marshall, of Gainsborough, were interested in, provided that that gear achieved the claim of wholly eliminating both cylinder back pressure, wire drawing and waste of steam by condensation.

Sir Henry Fowler, in a brief reply to the discussion, said he had kept himself in touch with what was being done in Austria, but did not adopt the bonus system in force there, by which the drivers and firemen were encouraged to reduce the fuel consumption, the reason being that weather conditions played such an important part in that connection. In the recent gale, for instance, the tractive effort required on a certain line was 50 per cent. more than it had been on the preceding day under the same working conditions of load. The great difficulty with pulverised fuel was the lack of a perfectly ash-free coal, and he believed that it would be in the direction of a large number of short flames that the difficulties on locomotives with pulverised fuel would be overcome. That prevented the cutting action of the fuel. High steam pressures were more difficult to apply to locomotives than to a stationary power station, although he had seen the

* No. I. appeared November 23rd.

working drawing of one locomotive designed for running at a much higher pressure than the 900 lb. mentioned by Dr. Taussig. So far as the Marshall gear was concerned, he had not yet made the calculations necessary to show whether an expenditure of £1000 per locomotive would be justified.

A paper by Dr. R. Lessing followed, in which was described a process for the cleaning of coal on the basis of separation by specific gravity only. A commercial plant, he said, was working at the Yniscedwyn Colliery of Amalgamated Anthracite Collieries, Ltd., and had been in operation for some time, dealing with 20 tons per hour of anthracite duff of a size $\frac{3}{16}$ in. to 0. A calcium chloride solution of suitable specific gravity was used as the separating fluid, but it could be replaced wholly or in part by other liquids when it was desired to modify the density, viscosity or other properties. From the commercial point of view, the crux of the problem was the removal of the calcium chloride solution from the coal and refuse, and its recovery in a form suitable for re-circulation through the process, but it was claimed that that no longer presented any difficulties.

The discussion was not a critical one, and was taken part in by only two speakers, apart from a written communication by Professor Henry Louis, who pointed out that the use of a similar method had been patented by Sir Henry Bessemer in 1858, but apparently was not a success. That gave Dr. Lessing the opportunity of replying that the Bessemer process of seventy years ago failed owing to the lack of such knowledge of the constitution of coal as we now had, which led to the attempt being made to clean the wrong type of coal.

In the afternoon of Wednesday, November 21st, three papers, dealing respectively with the Economics of Coal Production and Distribution, were read and discussed together, the authors being Mr. George Raw, of New Washington, who dealt with "Production"; Professor Henry Louis, who discussed "Preparation"; and Captain Roland Addy, managing director of the Carlton Main Colliery Company, who went into the problems associated with "Marketing." That meeting was presided over by Sir Richard Redmayne, who suggested the re-creation of the Trade Facilities Committee by the Government for the purpose of giving financial assistance to enable *bonâ fide* schemes of reorganisation of collieries, *qua* equipment, to be carried out. Mr. George Raw gave one striking conclusion in his paper on "Production" which is worth reproducing. He said: "Give us the mining engineer; give us that excellent type of British worker who has been too often overlooked, the loyal, capable, resourceful colliery official; give us the British miner with his excellent qualities and his fighting spirit, too often exercised in the past in the wrong direction; grant us deliverance from the politicians of all parties, and the British mining industry will deliver the goods."

Professor Henry Louis' paper put forward in a convincing manner the need for colliery owners to treat their coal in one way or another, and not to perpetuate the past policy of merely mining it and passing it on to the consumer, and he indicated the directions in which steps should be taken. Mr. Roland Addy's paper was a plea for the further extension of amalgamation among collieries and the formation of selling organisations. He argued that individualism had proved useless as an instrument of efficient marketing in the present economic structure of Europe.

There was a good discussion upon these three papers, some of which touched upon technical problems, and some upon the purely economic aspect. The chairman, in summing up the discussion, said it sounded a note of hope, and he would give way to no one in the belief that this country, the success of which was based on coal, would be maintained by coal. We must, however, put our house in order and move with the times. The fact that our neighbours were producing coal in increasing quantities, and that coal was being used more and more scientifically would not, in his opinion, militate against the coal trade of Great Britain, because in 1927 there was produced in the world—and presumably consumed—100 million tons more coal than in 1913. Economy in use did not mean an eventual restriction of output; indeed, it meant quite the reverse.

On Thursday morning, November 22nd, there was something in the nature of a symposium on Fuel Control in Industry, papers being submitted by Dr. Ing. F. Munzinger, director, Allgemeine Elektricitats Gesellschaft, Berlin, on "Electric Power Stations"; by Dr. E. S. Grunell, fuel department, Brunner, Mond and Co., Ltd., on "The Chemical Industry"; by Dr. Geoffrey Martin, on "The Cement Industry"; by Mr. T. A. Peebles, vice-president of the Hagen Corporation, Pittsburg on "American Practice and Experience"; and by Mr. J. R. Edwards, Messrs. Lever Brothers, on "Fuel Control in Lancashire Boilers." These five papers were taken together, and in spite of the fact that two hours were occupied in the actual discussion, it was impossible to deal adequately with all the points raised. Nevertheless, the speakers went into considerable detail concerning certain aspects.

The first paper was in a large measure a description of modern German electric power station practice in general and the plant at the Klingenberg electricity works in particular. In regard to boilers, the pertinent question was asked, "Are there any hopes in the near future of building a fundamentally different construction of high-pressure boiler or one working in accordance with a new principle for approximately the same price as an ordinary 500 lb. boiler?" The Löffler boiler was described and the inference was drawn that in it there was something which might provide the answer to the question propounded by the author. A plant with Löffler boilers had, said the author, been in operation for quite a long time in Witkowitz at 1800 lb. pressure and 910 deg. Fah., and a smaller one was working in Floridsdorf, near Vienna. Should the Löffler boiler succeed in satisfying the demands, then the high-pressure range between 500 lb. and 900 lb. would lose much interest, and only pressures between 300 lb. and 500 lb., and between 1400 lb. and 1800 lb. would be considered for public electricity stations. A case was also made out for the adoption of heat accumulation as a means for producing peak load demands in a cheaper manner than formerly, and the Ruths accumulator—which was specially developed by the A.E.G. for pure power station work—was mentioned. As a matter of fact, all the five German railway power stations are being equipped with this plant, and the first four public generating stations so provided are:—Oberlungwitz, with 21,000 cubic feet; Leipzig, with 26,500 cubic feet; Pforzheim, with 10,600 cubic feet; and Charlottenberg, with 177,000 cubic feet accumulator volume. Detailed figures of the operation of the Ruths accumulator were given by the author, and it was stated that in the near future it might be possible by this means to reduce the excess capital cost of 1400 lb. pressure plant over the 500 lb. plant.

The paper on "Fuel Control in Industry in the United States" was a brief statement of the general position without any attempt at technical detail. The development in America has been largely along the lines of improved combustion. As early as 1910 it was customary to install the horizontal water-tube type of boiler with the front header at least 10ft. above the stoker floor level, and the vertical bent tube type with distances of from 5ft. to 6ft. from the floor level to the centre line of the lower drum. These dimensions were gradually increased during the next four or five years to as much as 18ft. for the horizontal type of boiler and 12ft. for the vertical bent tube type. The furnace volumes, therefore, were large, permitting complete combustion with only a small amount of excess air. While the efficiency of combustion, said the author of this paper, was undoubtedly higher in America than in the average plant serving a similar purpose in Great Britain, the efficiency of heat absorption was considerably less. Economisers were not installed under ordinary conditions, and it was probable that the overall efficiency of plants for similar purposes in the two countries did not differ substantially. Engineers generally recognised that additional improvements in economy must come from the further reduction of escaping gas temperatures, and, consequently, the use of air heaters and economisers was becoming more general. It would undoubtedly be years, however, it was concluded, before the practice extended to plants in America similar to many of the small British plants, where economisers had long been considered standard practice. In such plants it was still impossible, under American conditions, to justify the investment necessary on the basis of the saving which could be effected. That situation, however, would be altered by an increase in the price of coal.

The final paper read on Thursday morning, dealing with fuel control in Lancashire boilers, by Mr. James R. Edwards, first drew attention to the fact that by far the greatest amount of steam used in industrial works and factories in Great Britain was generated from coal slacks burned in the furnaces of Lancashire boilers or in cylindrical boilers of similar type. Notwithstanding the increasing use of water-tube boilers, it was conceivable that boilers of the Lancashire type would continue to be used for generating steam in industrial works for many years to come, largely on account of their reliability, the low cost of maintenance and the comparative ease with which they could be operated at fairly high thermal efficiencies when burning slack, which was the cheapest fuel available in sufficient quantities. The most important steps recommended to be taken to stop the waste of fuel with Lancashire boilers were stated as—(1) the causes of the high cost of steam and the low efficiency and output of the plant must be found and stopped; (2) care must be taken to see that the operators fully understand what is expected of them, and that the boiler-house supervisors see that the instructions given are promptly and properly carried out; (3) all preventable waste in the use of steam must be stopped, both in power plants and in process plants; (4) only the most suitable fuels for the boiler plant should be purchased; (5) the weight of steam necessary per unit of product should be accurately determined, and when it was exceeded an explanation should be demanded from the responsible person. It was acknowledged that to put these suggestions into operation would mean some initial expense to the management, but if the question of fuel economy was properly followed up, handsome reductions in the cost of fuel and steam would certainly result.

Mr. A. Page (Chief Engineer to the Central Electricity Board), who was in the chair, expressed the view that there was still ample room for improvement in regard to fuel control in power production and manufacturing processes, and he could imagine nothing more congenial to the members of the Institute of Fuel than to join in a mass attack on rule-of-thumb and out-of-date methods of fuel utilisation.

Mr. W. M. Selvey referred to the work being done by the B.E.S.A. on coal sampling, and said that although it was *sub judice* it was important to impress upon those who were attempting to draw up an ideal system of sampling the necessity for bearing in mind that the sampling had to be carried out by a man who had already spent twelve or fourteen hours on the boiler-house floor getting his boilers into condition for test and then conducting the test.

Mr. F. H. Rosencrants, who discussed boiler design at some length, said he was much more impressed by Dr. Munzinger's favourable opinion of the Löffler boiler and the steam accumulator than he was by the equipment itself.

Mr. Charles Erith expressed the view that the problem tackled by the Löffler boiler had been attacked on sounder lines by the La Mont boiler, which had been in operation in Boston for about a year, and was about to be introduced into this country.

Mr. W. H. Patchell expressed disappointment that Dr. Munzinger had not given details of the working of the Klingenberg plant, because operating data of a station of such up-to-date design were badly needed. In order to secure such information, Mr. Patchell put a whole series of questions to Dr. Munzinger, who subsequently promised answers to them in writing. Like Mr. Rosencrants, he was not so sanguine about the Löffler boiler as the author was. A great deal had been heard about what that boiler was going to do, but so far it had been impossible to get operating data. As to welded drums, he had seen and admired many on the Continent, but there was only one insurance company in this country which would consider them seriously, although it might be that if an engineer insisted and told the insurance companies they could take the business or leave it, they might reconsider the matter.

Mr. C. P. Taylor, as one who had been associated with the design of something like half the cement kilns in this country, strongly criticised Dr. Geoffrey Martin's paper on details, and regretted that it contained no reference to pounds, shillings and pence.

Mr. H. E. Taylor put the case for welded boiler drums, and said that for twenty years the welding of drums had been carried out in this country on exactly the same lines as those adopted by Messrs. Thyssen in Germany, and many welds had proved to have an efficiency of 98 per cent. His firm had recently made a welded drum 54ft. long and 4ft. 6in. diameter, and on testing it to destruction found that the back of the drum had broken before the weld.

Some reply was given to the discussion, but the detailed comments of the authors will be communicated to the *Journal*.

In the afternoon a series of papers was read. They dealt with the steel industry, viz.:—"Liquid Fuel in Open-hearth Furnaces," by Martin J. Conway; "Fuel Control in Open-hearth Practice," by J. L. Bentley; "Fuel Control in Forge and Rolling Mill Practice," by H. C. Armstrong; and "Fuel Control in Hot-blast Stoves," by J. B. Fortune.

The first author, who is fuel engineer to the Luken's Steel Company, of Coatesville, Pa., set out in a concise manner the advantages of using oil fuel in an open-hearth furnace, and some figures of results obtained were quoted from such a plant. It was stated that the residuum from the cracking stills in the manufacture of lubricating oils and gasolene from crude oils were being used in America advantageously as open-hearth fuels. Either paraffin or asphaltic base oils could also be used as fuel oil, providing the sulphur content was not excessive, and it should also have certain other physical characteristics. Neither this paper nor the remaining papers read at the afternoon session indicated any strikingly new features, either of construction or operation, but they contained much valuable information of a routine character, which, whilst appearing somewhat obvious on the surface, needs to be impressed upon those engaged in the particular operations dealt with, and it was from that point of view that a careful perusal of them might be recommended. A great deal of information was given as to the means by which detail economies can be effected, and the papers are such as should be brought to the notice of those engaged in the operation and control of the apparatus and plant dealt with. For instance, the details of the results achieved at one of the open-hearth works with which the second author—Mr. J. Lloyd Bentley—is associated, is information which is not always readily available, and, accompanied as it was by a number of graphs relating to the furnaces under various conditions, forms a record which will well repay reference and study by those engaged in similar operations. Much the same may be said of the third paper by Mr. H. C. Armstrong, which dealt with forge and rolling mill practice, and collated information relating to general practice of the more advanced order, but did not give details of specific plants. The paper, however, is based upon the practice of John Brown and Co., Ltd., and Thos. Firth and Son, Ltd., the mere mention of whose names is sufficient to give confidence. Equally comprehensive was the final paper of the

Conference by Mr. J. B. Fortune, which discussed fuel control in hot-blast stoves, for, as was pointed out, the manufacture of pig iron in the blast-furnace is a metallurgical process entirely dependent upon the most rigorous fuel economy for its commercial success.

It was intended that Sir Robert Hadfield, F.R.S., should be in the chair at this meeting, but, in his unavoidable absence, Mr. F. W. Harbord presided.

The discussion, which was not a long one, was started by Professor H. E. Armstrong in his inimitable manner. He somewhat slyly said he had come to the meeting specially to congratulate Sir Robert Hadfield that at last Sheffield was beginning to concern itself with coal! It was just fifty years ago that he, with others, had started to train engineers in the way they should go scientifically, but the return for fifty years of that work seemed rather poor, because the present position of things scientifically in the iron and steel industries was a disgrace to civilisation.

Mr. F. J. Bailey rather resented the suggestion made by Professor Armstrong. He claimed that the papers contained records of work actually done, and they presaged more good work. He agreed, however, that the chemical industry was a long way ahead of the iron and steel industry in matters appertaining to day-by-day control.

Mr. H. Clifford Armstrong said that a great deal remained to be done in improving the fuel consumption in Siemens open-hearth practice; a good deal had been done already, but the great difficulty was that definite information was difficult to obtain. Different authorities gave different figures for various purposes.

Mr. E. Kilburn Scott said that he had been impressed by the fact that the boiler-house at the Billingham factory of Imperial Chemical Industries, Ltd.—which he believed was the largest boiler-house in the country—was in charge of a chemist. Mr. Scott made fun of the use of CO_2 recorders, some of which, he said, were anything from a quarter of an hour to a fortnight late, and he instanced a case in which all the CO_2 recorders were disconnected. At the same time, he advocated the use of steam meters, and mentioned that by their use Lever Brothers had been able to reduce the number of boilers by half.

The authors replied briefly, and what, on the whole, must be regarded as a successful Conference came to an end.

Metal Airship Construction.

No. I.

In our issue of August 31st, 1928, we published an article giving a general description of the 5,000,000 cubic foot airship R 101, now in course of construction at the Royal Airship Works, Cardington, Bedford. As recorded in that article, much of the metal work entering into the structure of the vessel has been fabricated by Boulton and Paul, Ltd., of Norwich, a firm which for a number of years past has been making a special study of light metal construction as applied to aeronautical purposes. Some account of Messrs. Boulton and Paul's earlier work in this direction was given in an article entitled "Metal Aeroplane Construction," which appeared in our issue of November 3rd, 1922; while in a second article, "Metal Aeroplane Developments," published in our issue of March 12th, 1926, we described the progress made since we visited the firm's works in the first-named year. We are now in a position to describe the firm's most recent practice with particular reference to the work which it has carried out for the Government airship R 101.

Several successful types of all-metal aeroplanes have been produced by Messrs. Boulton and Paul during the past six or seven years. The firm's connection with airship work dates from 1924, in which year it began a programme of research, design and construction on behalf of the Air Ministry. Towards the end of that year it produced two experimental longitudinal girders of a type which it suggested for use in the construction of R 101. This experimental type was ultimately adopted for the airship and was a development of the system which the firm had tried and tested and proved satisfactory in the construction of metal aeroplanes. At a later date Messrs. Boulton and Paul built a full-sized section of the airship for the purpose of proving, by tests carried out at Cardington, the soundness of the detailed construction and also of the general design of stiff transverse frame which had been evolved. As stated in our issue of August 31st, the R 101 marks a definite break with the Zeppelin tradition in that the polygonal transverse frames derive their stiffness, not from a multiplicity of cross bracing wires, but from their own triangulated structure.

All the tests having been passed satisfactorily, the firm received from the Air Ministry a contract for the complete hull, fins and rudders of the airship. During

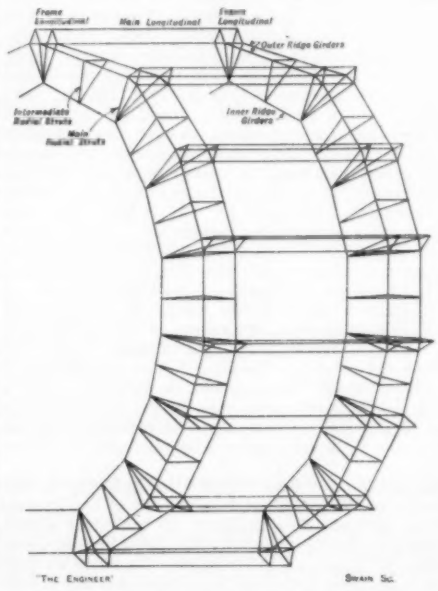


FIG. 2—DIAGRAM OF HULL STRUCTURE

the experimental and manufacturing stages close co-operation existed between the design staffs of the Royal Airship Works and of the Norwich works. To assist this collaboration the firm's chief engineer, Mr. J. D. North, was appointed by the Air Ministry as consultant in light metal construction to the Director of Airship Development. With the exception of the engine cars, the commander's observation car and the extreme tail end of the airship, the whole of the metal construction work was designed and made at Norwich and was transported to Cardington for erection by the staff of the Royal Airship Works.

In Fig. 1 we give a general outline of the airship, while in Fig. 2 we show in isometrical projection a part of two of the main transverse frames and other members of the hull structure. The special classes of members for the design and construction of which Messrs. Boulton and Paul were responsible were the main longitudinals, the frame longitudinals, the ridge girders, the radial struts, the shear wires, the floor bearers, the joints consisting of the conjunction of these parts and supplementary members for the attachment of the tanks, engines, passenger accommodation and so forth. The object aimed at was to produce all the parts at Norwich with a degree of accuracy which would enable them to be assembled at Cardington without fitting. In this respect, we learn, the intention has been completely realised, all the parts having gone together practically without a hitch. To enable this result to be achieved very great accuracy in the production of the parts had to be realised. The degree of accuracy required may be judged from the following table of the prescribed maximum limits.

Part.	Length. Feet.	Limits of error. Inches.
Main longitudinal girders	45	±0·030
Frame longitudinal girders	10	±0·020
Ridge girders	12	±0·025
Main radial struts	11	±0·015
Main radial legs	11	±0·015
Intermediate radial struts	11	±0·015
Bracing cables	45	+0·200 −0·000

In practice it was found possible to keep within one-third of these tolerances, except in the case of the main longitudinals.

At the time of our visit to Norwich in 1922 Messrs. Boulton and Paul were rolling or drawing the tubular or other sections required from an 85-ton nickel-chrome steel received from the manufacturers in the form of coiled strips and in the hardened and tempered condition. This material possessed a considerable amount of spring, but not so much as to prevent its being rolled or drawn into various sections. The use of such material for production on a small quantity basis was found to be practicable. For production in large quantities, however, it was unsuitable. The hardened material did not possess uniform mechanical properties throughout the length of the strip, with the result that the "spring back" from the roll or die was not consistent and several passes might have to be given before a reasonably uniform section was obtained. In addition, the design of the section was limited by the degree of ductility possessed by the hardened and tempered strips. At that time, however, no method had been found whereby the metal might be drawn or rolled in the soft state and subsequently heat treated. In the following year, however, such a process was evolved, and the problem was solved of heat treating the sections without causing them to lose the shape given them by the rolling or drawing process. By 1926, as we stated at the time, the firm's process of drawing or rolling in the soft state with a subsequent continuous heat treatment had been placed on a production basis, and by it standard sections capable of being assembled in a large number of different sizes and shapes were being produced for the aeroplane industry. As an outcome of this development the firm was enabled to produce sections which previously could not be realised, and in addition the speed of production and the uniformity of the product were greatly increased.

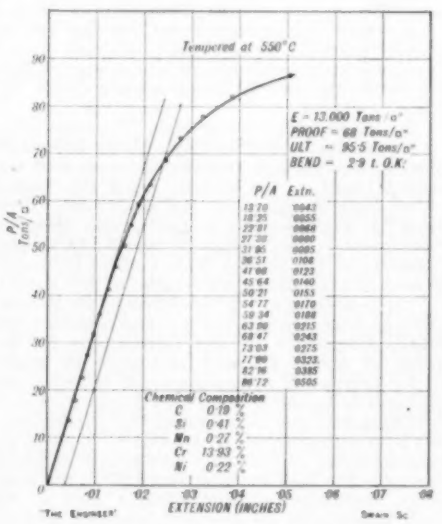


FIG. 3 STRENGTH OF STAINLESS STEEL STRIP

The principal material employed at that time for the rolling or drawing of parts called upon to bear primary aerodynamic stresses was a high-grade non-stainless steel. Work was, however, proceeding on the special problems involved in the rolling and drawing of stainless steel. The success achieved with that work was such as to justify the employment of stainless steel at many points in the structure of the airship R 101. The stainless steel strip used for all the airship members formed on the drawbenches and subsequently hardened and tempered by the continuous heat treatment process has the following composition:

Carbon	0·16–0·22 per cent.
Silicon	Not exceeding 0·5 per cent.
Nickel	Not exceeding 1·0 per cent.
Chromium	12·5–14·0 per cent.

After it has been hardened from a temperature of 960–1000 deg. Cent. and tempered it shows an ultimate strength of 88–95 tons per square inch. A typical stress-strain diagram for this steel is given in Fig. 3. For fittings, wiring plates and other details a different quality of stainless steel is used, namely, one having an ultimate strength of about 58 tons and possessing the following composition:—

	Per cent.
Carbon	0·14
Silicon	0·36
Nickel	10·00
Chromium	16·10

At some points in the structure use has been made of

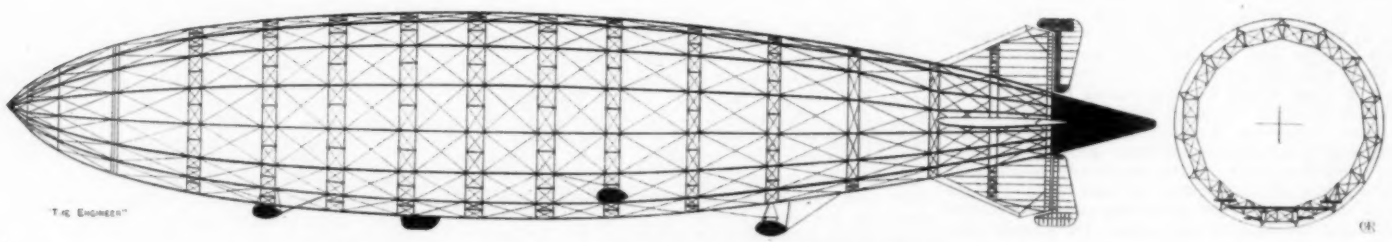


FIG. 1 ELEVATION AND SECTION OF HULL STRUCTURE OF AIRSHIP R 101

hardened and tempered solid-drawn high-tensile non-stainless steel tubing. The bulk of the tubular work, however, consists of close-jointed stainless steel tubes formed in the soft state and subsequently heat treated. Over 30,000ft. of such tubing have now been produced, a fact which provides good evidence that the process employed is a practical one for working on a production basis.

Of the other materials employed in the hull structure mention should be made of a 10–14 per cent. aluminium-silicon alloy used for die castings, of which many thousands are required. This alloy has an ultimate tensile strength in the chill cast state of not less than 12 tons per square inch and shows an elongation of not less than 7 per cent. on 2in. Numbers of steel stampings are also employed. The material used for them is a high-tensile steel with a minimum ultimate strength of 55 tons per square inch. The stampings after formation are heat treated. Duralumin is also used for some of the members, such as for the webs of certain of the girders and elsewhere in tubular form, either solid drawn or close jointed. It is employed in the heat-treated and fully-aged condition.

A particularly interesting material entering into the airship structure is a cadmium-zinc solder used for filling the conical end fittings of the cable bracings. It was required to find an alloy with the requisite low melting point and sufficient shear strength, and eventually Messrs. Boulton and Paul's laboratory staff discovered this new alloy, "cazin," as it has been named. It consists of 82·6 per cent. cadmium and 17·4 per cent. zinc, has a melting point of 263 deg. Cent. and possesses a shear strength of 7 tons per square inch. For the particular duty for which it has been evolved the alloy, we are informed, is strong enough in shear not to extrude from the end fittings under full load. Its melting point is such that its application does not affect the mechanical properties of either the cables or the end fittings. It can be applied to galvanised cables and zinc-protected end fittings without the use of any acid or chloride flux, only a little resin being required, and consequently the risk of electrochemical corrosion is eliminated.

The plant employed for the manufacture of the airship sections consists of four drawbenches, each 70ft. long, two rolling machines, one strip cutter, and one section cutter. The drawbenches, illustrated in Figs. 4 and 5, were entirely designed and made by Messrs. Boulton and Paul. The drive is effected through a friction disc in order to give a speed of pull which is variable and which can be changed very gradually. The dies are held in holders fitted to the channels of the drawbench and are locked in position by a downward-moving head operated by means of a hand wheel. The speed of pulling is controlled from the die head end of the bench by means of a push-rod, so that the operator setting the dies may also readily control the speed of the chain. Each drawbench is also fitted with an electric furnace at the die holder end and with a speed indicator. The speed of operation is, as will be noted later, of vital importance when the section is being hardened or tempered.

Sections such as the 1¾in. outside diameter close-jointed tubes for the longitudinals are made entirely on the drawbenches. The flat strip, in the softened condition as received from the makers, is passed in succession through a series of dies until the desired shape is obtained. During the drawing operations the gauge of the material is not altered. When close-jointed tubing is being made the edges of the strip are first corrugated to the required degree by drawing the material through a die. Thereafter the strip is drawn to a curved shape. The final seaming operation is carried out by pulling the curved and corrugated strip through a circular die and over a mandrel shaped so as to fold the corrugated edges over one another. Tubes up to 70ft. in length can be formed by this process.

If the material being operated upon is high-tensile non-stainless steel the drawing speed may reach about 10ft. per minute. If, however, it is stainless steel the drawing speed does not exceed 3ft. per minute. This low speed is imposed partly because the material is found to be unusually liable to score in passing through the dies and partly because the subsequent heat treatment forbids the employment during the drawing process of any lubricant likely to cause a carbon deposit when the section is passing through the heat treatment furnace.

The section, having been formed in this way, is next hardened. The wire-wound electric muffle furnace is fitted with automatic temperature control. On the entry side of the furnace a die is set up, the bore of which is such that some, but not too much friction is offered to the passage of the section through it. The furnace is heated to the required temperature —1050 deg. Cent. in the case of stainless steel—and a water-cooled die is fitted up in the die holder of the drawbench. This water-cooled die consists of a hollow cast iron die through which water is continually circulated. The section is pulled slowly through the furnace, the first die maintaining just sufficient tension on it while it is in the furnace to ensure straightness in the finished product. On leaving the furnace the hot section immediately enters the water-cooled die, which completes the quenching and hardening of the section. The speed of operation is kept constant under the control of the speed indicator. The speed employed depends upon the class of steel being operated upon, the form of the section, the gauge of the strip from which the section was formed, and the mass of steel per foot of section.

After being hardened the section is tempered. The process employed is very similar to the hardening process except that the speed of operation is different, and a different furnace temperature is employed—420–450 deg. Cent. in the case of stainless steel. In order to speed up the rate of working two furnaces arranged in tandem are employed.

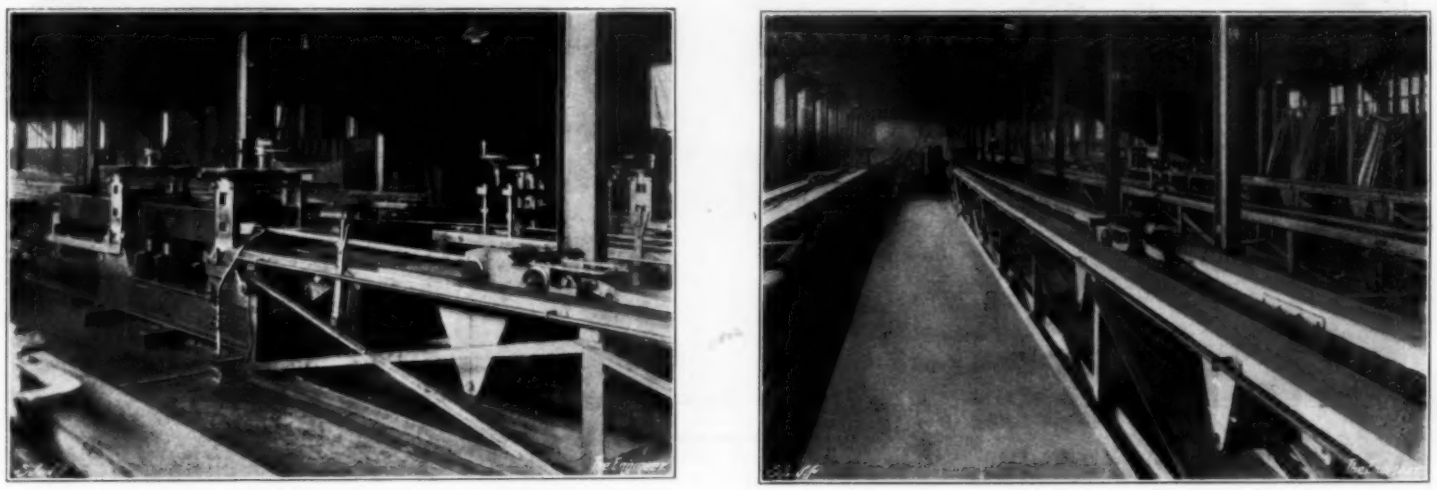
It may here be remarked that the finished hardened and tempered section is found to be more uniform in its mechanical properties than the sections obtained after many years' quest, from steel strip hardened and tempered in the coil before drawing. With coil-treated strip a variation of as much as 25 tons per square inch was frequently found in the tensile strength along a length of 60ft. To determine how the new method compared in this respect with the old a 50ft. length of close-jointed stainless steel airship tube was taken at random and cut up into short lengths. The size chosen was 1¾in. outside diameter by 20-gauge, the most difficult section to deal with from the heat treatment point of view. The ultimate strength ranged from 88·3 to 93·0 tons per square inch.

For cutting the sections to length a mild steel disc of about 16-gauge running at a high speed is found to provide a quick and economical means. On the pieces cut off the ends Rockwell hardness and close-bend tests are carried out.

As an alternative to the drawing process the sections may be formed by rolling the strip to the desired shape. The strip is passed at a rate of about 10ft. per minute between a series of horizontal and vertical rolls, which gradually bring the strip to the required section and close it in. Hardening and tempering follow in the same manner as for drawn sections.

In the formation of sections in duralumin the strip is first cut to width on the strip cutting machine. The coils are then heat treated in a molten salt bath, the temperature of which is under accurate pyrometric control. After being washed the coils are dipped in a bath of beeswax and tallow and are then formed to the required section either by the drawing or rolling process. No subsequent heat treatment is given to the finished sections. The rolling or drawing work is carried out on the material within the first two hours of the incubation or ageing process. The drawing speed in this material may reach 30ft. per minute.

(To be continued.)



FIGS. 4 AND 5—DRAWBENCHES AT BOULTON AND PAUL'S NORWICH WORKS

WICK ELECTRICITY SUPPLY.

A NEW power station for supplying the town of Wick, Scotland, with power and light was recently put into operation. At present there is a 132 horse-power crude oil engine, which can be started from rest by compressed air, and can be put on full load in 5 seconds. It is directly connected to a dynamo supplied by the English Electric Company. Foundations have been provided for a second set, which will be installed as soon as the load demands it.

At the other end of the building a water turbine has been installed. The turbine is driven by the water from the Mill Dam, and can develop a maximum of 60 brake horse-power. It runs at 1000 revolutions per minute and is connected to a dynamo made by the Electric Construction Company, of Wolverhampton.

Behind the generating sets is a nine-panel Ediswan switchboard, which controls the whole supply. Two feeders leave the station, one supplying a distributing pillar in the High-street, and the other a pillar at Francis-street corner. Ultimately, a third feeder is to be run in Huddart-street, to connect with the main at present laid as far as the South Public School.

Off the main engine-room there is a small room in which an air starting bottle is housed. The compressor is motor-driven. There is also a motor booster set for charging the batteries and a service fuel tank. Directly above there is a room containing batteries with a capacity sufficient to give the necessary lighting during the night, and above this room there is a water supply tank of 2000 gallons capacity, which is used to supply the cooling water for the engines. The water for the tank is drawn from the supply to the turbine, and a standby supply can be obtained from the main. At the end of the building there is an oil storage tank, capable of storing 800 gallons of fuel. The end of the station nearer the town is temporarily covered in with corrugated iron, so that, if necessary, one or more larger power sets can be installed.

Practically the whole scheme was developed from the late Mr. Arnott's original plans. Mr. Arnott was the engineer appointed by the Council at the commencement of the scheme. Current is supplied to the consumers on the three-wire direct-current system, at a pressure of 460 volts for power and 230 volts for lighting and domestic purposes. The majority of the main cables are laid underground, but some of the distribution has been planned on the overhead system.

BOOKS RECEIVED.

Production Design. By J. K. Olsen. London: The McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 15s. net.

Winter Construction Methods. By C. S. Hill. London: The McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 15s. net.

Motor Shipping: The New Era in Sea Transport. By A. C. Hardy, B.Sc. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 15s. net.

Land Drainage and Reclamation. By Q. C. Ayres and D. Scoates. London: The McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 20s. net.

The General Properties of Matter. By F. H. Newman, D.Sc., and V. H. L. Searle, M.Sc. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 25s. net.

Shearing Machines for Steelworks. By F. H. Roberts. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

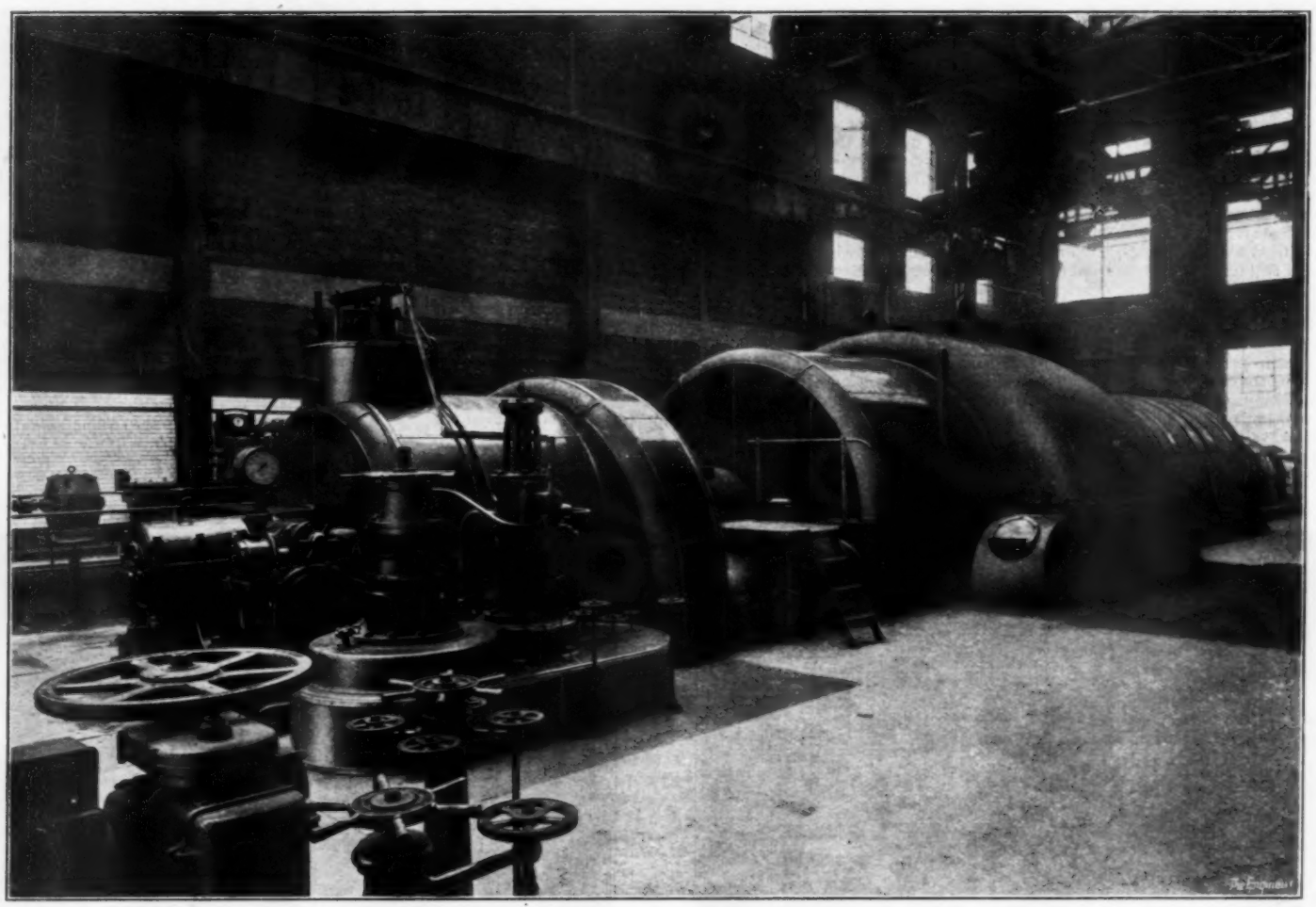
Automaton or the Future of the Mechanical Man. By H. Stafford Hatfield. London: Kegan Paul, Trench, Trubner and Co., Ltd., 68, Carter-lane, E.C. 4. Price 2s. 6d. net.

Driving Chains and their Application to Power Transmission. By K. B. Jacob. London: The Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, S.W. 1. Price 2s. net.

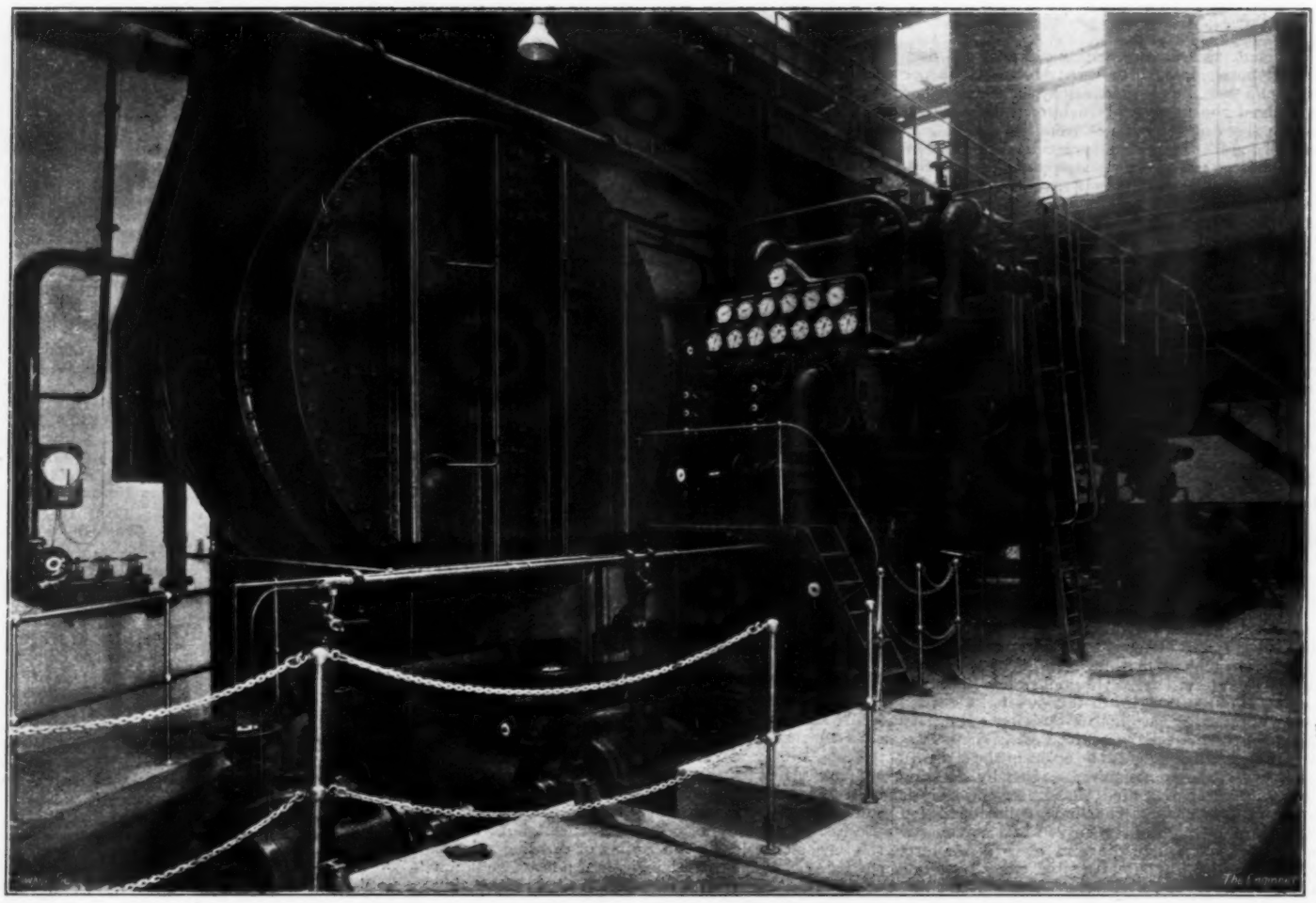
Conduction of Electricity Through Gases. Third edition, Volume I. *General Properties of Iron: Ionisation by Heat and Light.* By Sir J. J. Thomson, O.M., F.R.S., and G. P. Thomson, M.A. London: Cambridge University Press, Fetter-lane, E.C. 4. Price 25s. net.

BARTON POWER STATION EXTENSION

(For description see opposite page)



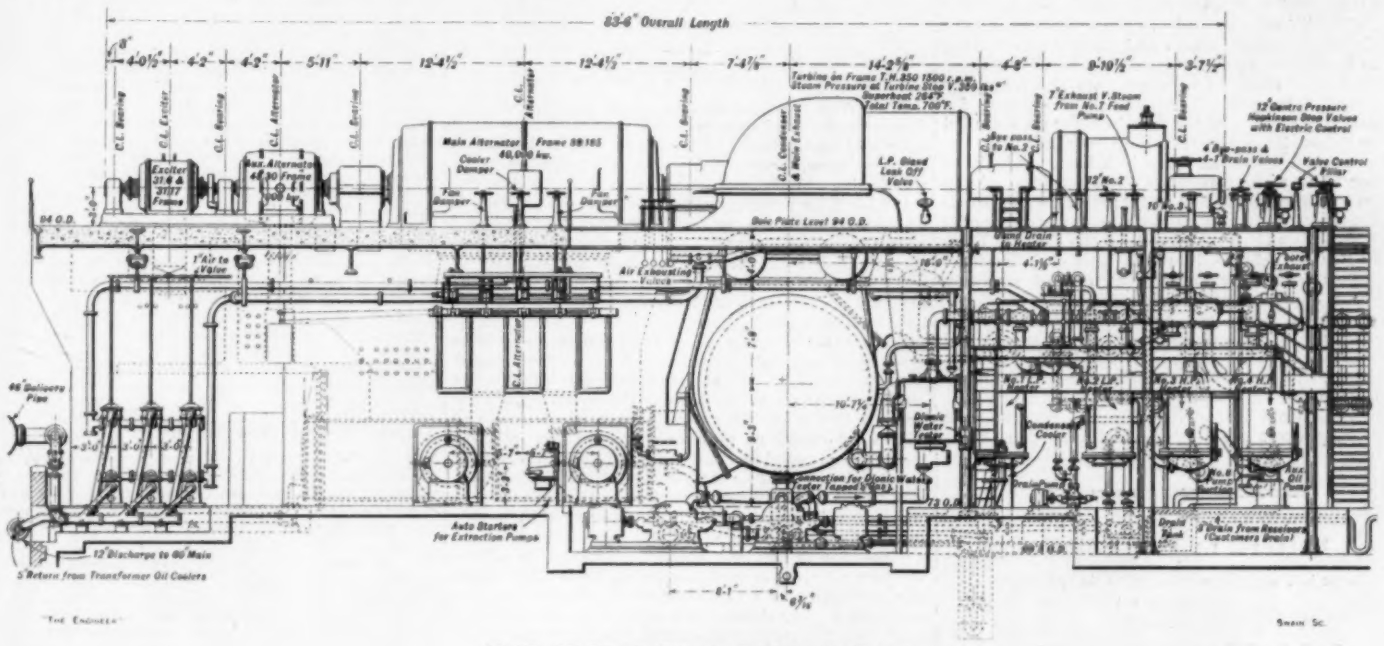
40,000-KILOWATT STEAM TURBO-GENERATOR—METROPOLITAN-VICKERS



CONDENSING PLANT—RICHARDSONS, WESTGARTH AND MATHER AND PLATT

Barton Power Station Extension.

THE extension of Barton power station, which was opened on Thursday, 29th inst., consists of an enlargement of the existing boiler-house by the addition of a second bay and the erection of a new turbine-house which accommodates a 40,000-kW turbo-generator. The original buildings have been followed in design and construction, and the new turbine-house occupies a position corresponding to that of the old turbine-house, but on the opposite side of the extended boiler-house. The buildings are generally of steel frame construction, with walls of brick in cement mortar. The roofs are of lattice girder design, and are covered with reinforced concrete slabs, finished with rock asphalt. The new turbine-house measures 176ft. in length, 70ft. 10¼in. in width, and is 62ft. high; the boiler-house measures 100ft. by 50ft. by 90ft. high; and the switch-house is 128ft. by 41ft. 7½in. by 49ft. 6in.


82'-6" Overall Length
Main Alternator Frame 59/165 40,000 kw.
Turbine on Frame T.H.350 1500 r.p.m. Steam Pressure at Turbine Stop V. 350 lbs.
Superheat 264°F. Total Temp. 706°F.
L.P. Glaud Leak Off Valve
12" Centro Pressure Hopkinson Stop Valves with Electric Control
Boiler Plate Level 94 O.D.
Air Exhausting Valves
Auto Starters for Extraction Pumps
12" Discharge to 60' Main
5" Return from Transformer Oil Coolers
Dionic Water Cooler
Condenser Cooler
Drain from Receiver (Customer's Drain)

40,000 kW STEAM TURBO-GENERATOR PLANT

BOILER-HOUSE.

In the boiler-house, three Babcock and Wilcox marine type water-tube boiler units, two of which

THE NEW BUILDING

are stoker fired while the third is equipped for burning pulverised fuel, have been installed. The last-mentioned has been erected in the original section of the boiler-house. The stoker-fired boiler units are of somewhat different design from those first installed, and have a higher steaming capacity. Each unit is completely equipped with a steel tube economiser, integral superheater, air heater, forced and induced draught apparatus, a steel chimney with a grit arrester, and Liptak flat double suspension furnace arches with radial ends. The normal evaporative capacity of the powdered fuel boiler is the same as that of the stoker-fired boilers, but it has a greater overload capacity. There are 4363 water tubes, 462 tubes in the economiser and 2220 tubes in the air heater, the total heating surface being 42,139 square feet. The furnace of the powdered fuel boiler has water-tube walls protected by slabs of refractory material and a water screen floor. It has fourteen fuel burners, ten being vertical and four horizontal. The fuel is supplied on the bin and feeder system. In this the coal, after passing through the dryers in which the contained moisture is evaporated by heat from the flue gases, is admitted to the pulverising mills. Thence it is pumped, mixed with compressed air, through pipes and pneumatically operated valves into bins. From these bins, after being weighed, the finely powdered fuel is fed to the burners. The operation of the boiler is controlled from an upper platform and the pulverising plant from the firing floor. The pneumatic control gear for the fuel valves is also operated from the lower level. A magnetic separator is provided for the purpose of removing iron fragments from the fuel prior to its admission to the pulverising mills. A noteworthy feature of this steam-raising unit is the size of the furnace chamber and the height of the boiler, the distance from the firing floor to the centre of the boiler drum being 40ft.

For driving the various fans, pumps, coal feeders, &c., in connection with the powdered fuel boiler, thirty-three electric motors of varying sizes are employed. Two new boiler feed pumps, by Mather and Platt, Ltd., are installed, two being motor driven and one is driven by a steam turbine.

TURBINE-HOUSE.

In the turbine-house a steam turbine of the Rateau impulse type, coupled to a three-phase alternator of 40,000-kW capacity, has been installed by Metro-politan-Vickers Electrical Company, Trafford Park. The turbine has separate high and low-pressure cylinders arranged in tandem, and upon an extension of the generator shaft is mounted the rotor of a 1000-kW house service alternator, and beyond that again are the exciters. This makes an abnormally long machine, the overall length being 82ft. 7in. The turbine runs at a speed of 1500 revolutions per minute, and has twenty-three expansion stages in the high-pressure cylinder, sixteen stages in the low-pressure end, plus a multi-exhaust. The velocity of the blade tips on the last wheel, when running at full speed, is 808ft. per second. For feed-water heating, steam is bled from four expansion stages. The main alternator is the largest which has yet been built in this country. It generates three-phase current at 6600 volts pressure, and is of similar design to those of a smaller size already in use at Barton. Like them, it is ventilated on the closed air circuit principle, the air being cooled by water from the main circulating system. The total weight carried by the shaft, without the weight of the shaft itself, is over 100 tons. As a standby, a separate motor-driven exciter is provided. The condensing plant is by Richardsons, Westgarth and Co., Ltd., and the circulating water for the condenser is provided by two motor-driven pumps made by Mather and Platt, Ltd. Two three-stage steam ejectors maintain the vacuum in the condenser and the condensate is abstracted by two motor-driven pumps. One of these is capable of dealing with the whole of the water of condensation, when the set is on full load, and each of the three-stage ejectors will deal with 60 per cent. of the air, so that both ejectors are

TABLE I.—*Particulars of Boilers.*

Item.	Pulverised fuel boiler.	Chain grate boilers.
Normal rating, lb. per hour	130,000	130,000
Maximum rating, lb. per hour	170,000	150,000
Firing	Pulverised fuel	Chain-grate stokers
Steam pressure (gauge), lb. per sq. in.	375	375
Temperature at superheater outlet, deg. Fah.	750	750
Heating surface of boiler, sq. ft.	14,055	18,487
,, ,, superheater, sq. ft.	3,630	3,890
,, ,, economiser, sq. ft.	5,015	6,800
,, ,, air heater, sq. ft.	19,439	29,100
Total heating surface, sq. ft.	42,139	58,277
Grate area, sq. ft.	—	559
Feed water temperature, deg. Fah.	300	300
Flue gas final temperature, deg. Fah.	333	294
CO_2 at air heater outlet, per cent.	13	11
No. of burners and feeders	14	—
Capacity of driers (each), tons per hour	10	—
,, mills (each), tons per hour	3·25	—
,, fuel pumps (each), tons per hour	12	—

TABLE II.—*Particulars of 40,000-kW Turbo-alternator.*

Turbine—	
Type	Impulse, two-cylinder, tandem
Steam pressure at stop valve	350 lb. per sq. in (gauge)
Steam temperature at stop valve	700 deg. Fah.
Vacuum at exhaust	29in. Hg.
Speed	1500 r.p.m.
Number of stages—H.P. cylinder	23
,, L.P. cylinder	16 + multi-exhaust
Number of wheels—H.P. cylinder	23
,, L.P. cylinder	18
Mean diameter of H.P. blading	3ft. 6in.
Diameter of last L.P. wheel, over blade tips	10ft. 3½in.
Thrust bearings (two)	Michell
Gland packings—H.P.	Steam labyrinth
,, L.P. inlet	Steam labyrinth and water paddle
,, L.P. outlet	Water paddle
Number of stages at which steam is bled	4
Temperature of feed water leaving last heater	300 deg. Fah.
Type of coupling between H.P. and L.P. rotors	Flexible
Main alternator—	
Maximum continuous rating	40,000 kW
Voltage	6,600
Power factor	0·8
kVA	50,000
Excitation voltage	215
System of ventilation	Closed air circuit
Quantity of air required	100,000 cub. ft. per min.
Area of cooler	15,600 sq. ft.
Type of coupling to turbine rotor	Semi-flexible
House service alternator—	
Maximum continuous rating	1,000 kW
Voltage	420
Power factor	0·8
kVA	1,250
Excitation voltage	98
Quantity of air required	4,000 cub. ft. per min.
Air cooled by main alternator cooler	—
Type of coupling to main alternator rotor	Semi-flexible
Exciters—	
Exciters for main and house service alternators under one yoke	
Rating—Main exciter	108 kW
,, H.S. exciter	15 kW
Ventilation	Rotor fans
Type of coupling to H.S. rotor	Semi-flexible
Condenser—	
Type	Contraflo-regenerative
Total cooling surface	32,000 sq. ft.
Quantity of circulating water	2,005,000 gallons per hr.
Circulating water pumps—	
Drive	A.C. motor
Capacity (each)	17,600 gallons per min.
Head (each)	38ft.
A.C. motor rating	280 B.H.P.
Speed	588 r.p.m.
Extraction pumps—	
Drive	A.C. motor
Capacity (each)	670 gallons per min.
Speed	970 r.p.m.
A.C. motor rating	60 B.H.P.
Air ejectors—	
Capacity (each)	168 lb. of condenser vapour per hour

required under full-load conditions. All the auxiliary motors are of the alternating-current type. A 100-ton crane by the Clyde Crane and Engineering Company, Ltd., has been provided in the turbine-house.

TRANSFORMERS AND SWITCHGEAR.

The whole of the current at the generated pressure of 6600 volts is stepped up to 33,000 volts by two transformers supplied by Metropolitan-Vickers, each being of 25,000-kVA capacity, and the largest built so far in this country. The weight of each transformer is 69 tons, and they were transported complete and filled with oil from the works to the site. The switchgear is by the same makers and presents no feature calling for special notice. Alterations have been made in the control-room to accommodate the necessary additional apparatus. The 420-volt switchgear for the auxiliary plant is of the metal-clad type, supplied by the British Thomson-Houston Company, Ltd.

The extensions which have just been made have increased the main generator plant capacity of the station to a total of 122,500-kW representing, approximately, three-quarters of the total capacity of the site. The foreshadowed development of the Central Electricity Board's scheme, however, is of such a nature that plans for further extensions are of necessity already in course of preparation.

The extensions of the Barton plant have been designed, the plans and specifications prepared, and the construction work supervised by Mr. H. C. Lamb, M.I. Mech. E., M.I.E.E., and the engineering staff of the Manchester electricity department. The consulting engineers responsible for the general civil engineering work are C. S. Allott and Son, Manchester.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE VENERATION OF THEORY.

SIR,—I feel that most engineers will welcome the salutary admonition in your leading article, not to venerate theory for theory's sake. I think, however, that the suggestion that theory and practice seldom accord should not pass unchallenged. Theory divides into two parts: one, the hypothesis; two, the logical consequences of that hypothesis. The function of mathematics is to deal with the second part only, and the engineer may well complain if the mathematician's logic is at fault. He has far less cause to complain of the unreality of the hypothesis. Surely the engineer can be satisfied with a mechanistic philosophy. If the boundary layer hypothesis allows the vortex phenomena of aerofoils to be discussed in terms of an incompressible fluid and enables experimental results to be forecast with a high degree of accuracy, there is no cause for alarm in the unreality of the medium. If the engineer fails to appreciate the limitation of the assumptions, so much the worse for him; he is in danger of degenerating to dependence on the last refuge of mental bankruptcy, the pocket book formula. It is unfortunate, perhaps, that some writers tend to gloss over their assumptions, and all theoretical work requires the closest scrutiny before it can be applied to practice. The accuracy of a thesis is open to argument, the results of the practical application of inaccuracies are only too painfully and expensively manifested.

Surely, unless the mathematical logic is at fault, it comes to this: if theory and practice appear to disagree we are theorising about one thing and practising another. As this is almost invariably the case, the agreement between theory and experiment is on the whole extraordinarily good.

Few structures are in reality statically determinate, though we often conveniently assume that they are. In the matter of failure under steady loads the very fact that our materials under heavy stress do not behave elastically saves us from the errors of our assumption. The distribution of stress in a lug as revealed by optical analysis hardly suggests much confidence in the crude calculations of engineering practice; but here again we are better served than we have right to expect. How happy we should be if we could be similarly protected from fatigue failures. The Euler-Bernoulli beam theory is a good example of the artificiality of engineering calculations—but how useful! Against the danger that these artificial solutions to the problems of the mechanisms underlying natural phenomena may not be unique we are protected by the economy of hypotheses. If the mechanism assumed will enable us to forecast experimental results with sufficient accuracy we need not be worried about its reality. As engineers are, fortunately, seldom concerned with material objects whose relative velocity approaches that of light, they have not found it necessary to throw overboard Newton in favour of Einstein on the grounds of a nearer approach to reality.

There is, I suggest, some justification for the engineer employing structures or mechanisms susceptible to analysis. Time and money on trial and error may be saved on the one hand or, in the absence of experimental evidence, the loss of efficiency may be regarded as an insurance premium against disaster. Fortunately, we can fall back in emergency on step-to-step integration, so our scope is not quite so limited as suggested.

In spite of all this the engineer who practises an art does well to beware of too much reliance on the scientific method. Some psychologists tell us that excessive devotion of the conscious mind to logical reasoning tends to weaken the connecting link with the subconscious mind of perfect memory and first-class deductive capacity.

The cultivation of engineering intuition is as much a part of the training of an engineer who expects to do creative work (design) as is the acquirement of technique to refine and verify the raw material of his intuitions, and the proper field for such cultivation is the shop or yard, not the university laboratory. JOHN D. NORTH.

The Royal Aero Club,
3, Clifford-street, W. 1,
November 28th.

A CONDENSER PUZZLE.

SIR,—With reference to your recent article, "A Condenser Puzzle," and subsequent correspondence, we would refer your readers to our booklet on the "Weir Regenerative Condenser," from which we take the following quotation dealing with the question at issue:—

"With Weir regenerative condensers in which there is no cooling of the condensate, we have occasionally recorded figures in which the condensate temperature is higher than the steam entering the condenser. In the majority of such cases this anomaly can be traced to errors in the recorded temperatures or in the vacua from which they have been deduced.

"There still remain a number of cases where we have established authentic records of this supercooling phenomenon. Our explanation of such cases is that under certain conditions in the turbine the steam apparently expands like a perfect gas without condensation, and follows a temperature pressure curve different from the normal temperature-pressure curve associated with steam. This results in a colder temperature at the exhaust pipe than would normally be appropriate to the vacuum. As soon as condensation occurs in the condenser the stable and ordinary temperature condition is re-established.

"Needless to say, the above phenomenon is utterly unconnected with the condenser design, but is only brought into prominence in a condenser which does not cool the condensate. Any claim that higher condensate temperatures than the steam temperature can be achieved as a result of the internal design of the condenser in the maintenance of velocities, &c., cannot, in our opinion, be substantiated." G. AND J. WEIR, LTD.

Glasgow, November 27th.

STANDARDISED ENGINE TESTING APPARATUS.

SIR,—The lack of any sort of standardisation of testing apparatus amongst internal combustion engine manufacturers leads to claims being made as regards fuel consumption which in many instances are obviously inaccurate, and in some cases not far removed from the ridiculous, but which may, notwithstanding, find some credence amongst non-technical purchasers.

Manufacturers who test their engines using reliable apparatus of accepted modern type are liable to be placed at considerable disadvantage when competing with makers who use out-of-date methods.

The matter is rendered all the more difficult by the impossibility of checking statements based on inaccurate testing conditions, and for the protection of the industry it seems that some agreement should be come to amongst manufacturers to standardise measuring apparatus and methods of testing, so that only tests obtained under conditions which are beyond question should be published.

It would be helpful if makers of internal combustion engines, and others, would consider the matter, and through your columns state whether such a proposal commends itself to them.

ERNEST W. PETTER.

Ipswich, November 28th.

BELT DRIVES.

SIR,—Reading your abstract of Professor Swift's paper on his belt drive research, I notice that Professor Charnock spoke as if the "Lenix" drive was something quite novel. I am impelled to ask this question: What is precisely the patentable novelty in the "Lenix drive"?

Messrs. Sulzer seem by their advertisements to lay stress on the increase of arc of contact possible in the case of short centres. But the use of a jockey pulley for this purpose was known to and used by millwrights when I was a junior apprentice fifty years ago.

It was so used by Dr. Hopkinson at the Manchester Electric Light Station nearly forty years ago. I have used it myself with the same object years before the patent was noted in your "Patent Abstracts" columns.

Is this another case where well-known methods are patented by foreigners and brought back here in a new coat and sold to people who, if they knew, need not pay a halfpenny royalty to any one.

November 27th. GEO. T. PARDOE.

AN unusual incident occurred on November 9th at the opening bridge which carries the London and North-Eastern main line over the river Ouse on the north side of Selby Station. The bridge had been opened for examination purposes, but when it was restored the locking mechanism that secures alignment and level with the fixed track would not act. In the absence of the required interlocking it was not considered safe to run trains over the bridge, and traffic had to be diverted until the irregularity was corrected.

American Engineering News.

Stainless Iron for Airships.

TESTS have been made at the United States naval aircraft factory to determine the availability of stainless iron alloys. It was found that stainless steel was not satisfactory, as it lacked ductility, was more difficult to machine, would corrode if given heat treatment, and would require such a high temperature for heat treatment as almost to preclude the use of brazed joints. On the other hand, the stainless iron alloy tested could be soldered, machined and pressed. They have an advantage also in resisting corrosion more effectively than some other alloys of similar strength, although less resistant than the higher chromium alloys. Special attention is needed as to the temperature in heat treatment, as it affects the strength, while the rate of corrosion decreases with decreased tempering temperatures. When annealed, the metal had better tensile properties than those of mild steel, while the ultimate strength exceeds that of medium-carbon steel. Of two stainless iron alloys made by the electric process in bars and plates, one had 0·10 carbon, 0·42 manganese, 0·017 phosphorus, 0·018 sulphur, 12·3 chromium, and 0·19 nickel. The other had 0·04 carbon, 0·22 manganese, 0·016 phosphorus, 0·016 sulphur, 0·33 silicon, 13·4 chromium, and 0·13 nickel. They can be welded, but the work must be done by operators familiar with the peculiarities of stainless iron. Brazing is difficult, but soldering is done with little trouble. These alloys are being used increasingly in aircraft construction on account of the strength when hardened and tempered, the ease of fabrication, and the resistance to corrosion.

Geophysical Prospecting for Minerals.

This comparatively new system for determining the existence and position of minerals or ore bodies below the earth's surface by scientific methods is being given increased attention by American engineers. The methods may be classified as follows:—(1) Magnetic; (2) acoustic or seismic; (3) gravitational; (4) electrical. The last may be subdivided into the self-potential method; the surface potential method; and the inductive method. Magnetism is applicable mainly with iron ores, but there are other metallic minerals which affect very delicate instruments. Seismic or earthquake waves caused by explosions in test pits or borings may be detected by seismographs, and a study of the records may indicate certain features of the materials through which the waves have passed. This method has been used successfully in the oil well districts. As the gravitational force is greater with dense and heavy material than with relatively porous and light material, a very sensitive instrument capable of measuring slight differences in the attraction of gravity may give some indications of underground conditions and materials. The electrical method has been used most extensively for mining development, and most effectively by induction, but the instruments required are very delicate, the processes and calculations are complex, and only careful and experienced investigators can operate the system to practical advantage.

Mississippi Flood Protection.

The general scheme of flood protection works on the Mississippi River, as planned by the United States Army Engineers and approved by a special board of engineers, is to provide for a flood of 2,400,000 second-feet below Cairo, and 3,000,000 second-feet from the mouth of the Red River to the Gulf. But of this latter amount, only half will be carried by the river itself, the remainder being diverted through the Atchafalya River. Above the Red River, also, the main river will carry about 1,950,000 second-feet, any excess being diverted into the Boeuf River basin by means of blow-out or fuse plug levees, so designed as to wash out or blow out under heavy flood pressures. To relieve the channel just below Cairo and thus provide against excessive flood heights at that city, which is surrounded entirely by levees, a floodway or auxiliary channel will be provided to carry excess flood waters. For the protection of New Orleans, also, there will also be a great spillway or weir to discharge flood waters eastward into Lake Poutchartrain. The present system of levees will be raised and strengthened where necessary, and new levees built for the floodway channels and around the river basins which will receive flood waters. Levees and floodways will cost about £42,000,000, which, with £16,000,000 for revetment, £4,000,000 for contraction works, and £2,000,000 for dredging, will give a stupendous total of £64,000,000.

Small Double-acting Diesel Engine.

While the advantages of double-acting engines, in reducing weight and permitting smaller cylinders for a given power, have been recognised for Diesel engines of about 3000 H.P. and larger, there is difference of opinion as to the desirability of the double-acting system for smaller engines. It is interesting to note, therefore, that a double-acting Diesel engine delivering 300 H.P. from each cylinder has been designed and put in service by the Sun Shipbuilding Company, of Chester, U.S.A. It is of the two-stroke cycle type, with air induction. Its three cylinders are 16in. by 22in., and it runs at 165 to 180 revolutions. Each cylinder consists of an upper and lower barrel separated by an exhaust belt, the two barrels being fitted with liners and the lower barrel being supported on two A frames. On test runs its mechanical efficiency has been from 85 to 90 per cent. Closed cylinders, with a plain piston and the piston-rod carrying a crosshead which works in guides are used. In the top cylinder head the fuel admission valve is vertical, but that in the bottom cylinder head is horizontal. Each end of the cylinder has its fuel pump, operated from a cam shaft, which is driven from the crank shaft through a vertical shaft and helical gears. Owing to simplifications in design, which reduce the workmanship and expensive erection work, the labour cost is said to be only about half that of other engines of the same type. The engine is intended for both marine and stationary service.

Railway Matters.

DURING the first quarter of the present year the assistant inspecting officers of the Ministry of Transport held forty-one inquiries into the more serious accidents to railway servants, of which thirteen were fatal cases, leading to the death of sixteen men—in one instance three men were killed and in another two. Ten of the total were permanent way men. In eleven cases it was stated that there was want of care on the part of the deceased, and that the remaining five were due to misadventure.

WHEN Colonel Trench was holding his inquiry into the fatal collision of October 12th at Queen-street Station, Glasgow, some portion of the evidence was given in private. The reason for that course was made apparent when, on November 21st, the signalman was brought before the Sheriff on a charge of culpably neglecting his duty by signalling a train—the empty carriage train—standing in the centre road before a passenger train had cleared, whereby the trains came into collision and three passengers were killed. The man was released on bail.

THE Great Central Railway Company carried out, some years ago, wide extensions and reconstructions of the accommodation for the fishing vessels using its docks at Grimsby. Further additions have long been promised, but its successor, the London and North-Eastern, has not seen its way financially to proceed with the scheme. The railway company has now suggested that the Grimsby Town Council should promote a Bill and raise a loan to build the dock. The railway would pay, as yearly rental, whatever it cost the Corporation in interest and sinking fund. That has now been agreed to.

IN answer to a question in the House of Commons on November 12th, it was stated that in only one case within the last five years had a railway collision been followed by a fire caused by gas, and, in that case, no person was injured by the fire. It is, we think, a pity that the answer did not go on to say that the accident in question was at Old Oak Common on October 7th last year, and that Sir John Pringle reports that the fire, which was caused by the tail lamp of the train being broken and setting fire to gas escaping from a broken pipe, was quickly extinguished. Had the inquiry gone further back than "within recent years," it would have been seen that not since December, 1915, has there been a serious fire from that cause, and, including the above, only four minor fires—in 1916, 1918, 1919, and 1927.

IN a letter to *The Times* recently a correspondent suggested that there should be "a real shock-absorbing device"—other than a brake-van—between the engine and front passenger-carrying vehicle of every passenger train. The writer says that "such a device may lengthen the train a little but our lives a lot." Such a suggestion was made so emphatically at the time of the buffer-stop collision of July 27th, 1903, at St. Enoch's Station, Glasgow, when sixteen passengers were killed, that Sir Arthur Yorke, in his report thereon, was constrained to say on that subject: "Not only would this necessitate a large and unproductive increase in the rolling stock of all railways, but it would also entail a general increase in the length of platforms and seriously affect the working expenses. Moreover, end-on collisions are at least as frequent as head-on collisions, and, if the precaution is to be carried out logically, the same measure would be as necessary at the end of every train as at the head."

THE extent to which engines are employed for assisting purposes and have to run "light" is indicated in the annual reports of the railway companies and summarised in the Railway Returns. For every 100 passenger train miles the average mileage assisting, for the whole of the companies, is 1·25; the figures for the grouped companies are:—Southern, 0·21; Great Western, 0·42; London and North-Eastern, 0·87; and London, Midland and Scottish, 2·33. For freight traffic the average for all the companies is 4·45, and for the grouped companies, in the order named above, 0·76, 3·67, 2·13, and 6·99 respectively. The last is made prominent by the figure of 11·45 for the Midland area, where double-headed freight trains are regarded as profitable because the trains get over the road more quickly. The average "light" running for 100 passenger train miles is 5·53, towards which the four companies contributed 5·53, 3·74, 5·47 and 6·42 respectively; for 100 freight train miles the "light" running averaged 12·58 miles and the companies' respective shares were 16·77, 10·80, 12·65 and 12·83. How expensive is the item of shunting may be judged from the fact that to every 100 train miles in freight traffic there are 78·26 freight shunting miles; in passenger traffic the relative figure is 7·78.

THE first fatal railway accident of the present year was the derailment on June 6th of the Lincoln and Tamworth mail at Swinderby, when nine passengers and eight Post-Office servants were injured, and one of the former succumbed to his injuries the same night. Colonel Sir John Pringle inquired into the accident, which was somewhat noteworthy because the driver of an express in the morning noticed the line as then out of alignment, and it was apparently put right, but again failed when the mail passed. The latter train was worked by a tank engine of the 0–6–4 type, and it was only on the previous March 12th that tank engines of that type were first used for fast trains. The road had only been relaid in 1921–22, but it was peculiar in that, though on a tangent, a superelevation of from ¾in. to 1in. was allowed in order, says Sir John Pringle's report, "to counteract any weakness—presumably in the bed of the track—on the cess side." Unfortunately the superelevation was not uniformly maintained, but varied from ¾in. to 1¾in. over a distance of ten or more rail lengths. Another factor was that the Trent ballast of the sleeper bed of the track did not afford the resistance required against slewing, and there were only two coach screws in each chair instead of the customary three. The loading deflection of the vertical coil springs of the leading axle also varied—the right hand showed 1·21in. and the left 0·86in., as against the standard of 1·02in. Finally, the train was running at 60 m.p.h. over a track which was not of sufficiently high class to justify such a speed. It should be added that the irregularity in the track discovered on the morning of June 6th was evidently done by the same engine and train the previous evening.

Notes and Memoranda.

THE suitability of wax extract from coal tar produced in the low-temperature carbonisation of coal for use as a base in the manufacture of coloured wax crayons is being investigated at the Pittsburg Experiment Station of the United States Bureau of Mines.

AN old iron penstock, made of Scottish plates, which was laid fifty-eight years ago in California, has been dug up and put in service again, as it is still in good condition. It is 30in. in diameter and the plates are ¼in. thick. A section tested hydraulically withstood a pressure of over 600 lb. per square inch.

IN a paper contributed to *Brennstoff Chemie* by Herr O. Künle, it is stated that the influence of the temperature of coking on the yield and composition of the coke from a Saxon coal has been investigated by the use of the crucible method for the determination of volatile matter. The amount of volatile matter evolved rose from 24·9 per cent. at 400 deg. to 450 deg. Cent., to 47·8 per cent. at 1000 deg. to 1020 deg. Cent. At temperatures below about 350 deg. Cent. considerable oxidation occurred. After ten hours' heating at 225 deg. Cent. the oxygen content of the coal had risen from 9·9 per cent. to 23·8 per cent. The oxygen content of a sample of fusain, separated from the coal and heated under the same conditions, rose from 5·5 to 17·4 per cent.

DRY cell batteries for tripping high-tension, 7800-volt and 13,200-volt oil circuit breakers at customer installations where no direct-current source is available, have been used by the United Electric Light and Power Company, New York, since 1926, with very satisfactory results. The average life of a dry cell battery operation is ten months. Prior to that time the breakers were tripped by means of a two-coil direct-trip alternating-current attachment. This attachment was operated from the same current transformers that operated the relays. At each installation there already was a battery of twenty-four dry cells, connected twelve in series and two groups in parallel, having an open circuit voltage of approximately 18·5 volts, for furnishing the direct-current needed for the metering equipment.

THE work of the intelligence section of the Building Research Station includes the systematic collection of information on the processes of manufacture of building materials of all kinds. In the course of this work a series of visits to certain foreign clay roofing tile works was undertaken in February, 1928, and it is thought that the impressions gained may be of interest to British manufacturers and others. The processes and equipment of four French, one Belgian and one Dutch roofing tile works are described, and it will be seen that, in the large works especially, where the organisation may be said to be on a "mass production" basis, that great attention is paid to mechanisation, the elimination of waste and unnecessary manual labour. A bulletin on the subject has just been issued by H.M. Stationery Office, price 6d.

A COMMUNICATION from the British Legation at Berne reports that at the end of 1927 there were 750,277 pedal cycles in use in Switzerland. This figure represented an increase of 129 per cent. since 1918, when 327,559 machines were in use. On the average, there is now one pedal cycle to every five inhabitants, as against one to twelve ten years ago. At the close of last year 160,639 cycles were registered in the Canton of Berne, and 106,929 in the Canton of Zurich. As regards motor cycles, Berne headed the list of cantons with 5492 machines, or about one-fifth of the total number of solo motor cycles registered in Switzerland on December 31st, 1927. The Canton of Zurich followed with 4585 machines; then came Vaud with 3093 machines; Aargau with 1965 machines; and Geneva with 1806 machines. Berne was also first in respect of motor cycle combinations, of which it had 602, as compared with 468 in Geneva, 414 in Zurich, 364 in Vaud, and 210 in Neuchâtel.

A TURBO-GENERATOR now under construction by the General Electric Company for the New York Edison Company is, says the *Engineering News-Record*, believed to be the largest single-shaft, single-unit electric generator in the world. It will be in the new East River generating station of the New York Edison Company at Fourteenth-street. The machine will develop 160,000 kW, or 215,000 horse-power. The steam generating units to be used in connection with the new turbo-generator will also be of unprecedented size. Four units, having an aggregate heating surface of 45,120 square feet each, will be installed. Each of the four will produce 550,000 lb. of steam per hour. In addition, the generating station will contain the largest pumping station in the world, with a total capacity of the circulating pumps of the condensers of 1,400,000 gallons of water a minute. This is double the quantity of water used by the New York City water supply. It will be taken directly from the East River and returned as rapidly as used.

FERROUS oxide is supposed to be formed about 570 deg. Cent. by the combination of $Fe + Fe_3O_4$; below 570 deg. Cent. the reverse action takes place. New experimental data concerning this reaction has been correlated by the American Bureau of Mines with older unsubstantiated work at temperatures above the melting point of ferrous oxide. These comparisons indicate that an increase in temperature decreases the percentage of FeO in the product; further, the comparisons indicate that the reaction to produce ferrous oxide purer than about 85 per cent. must necessarily take place at temperatures at which the materials are all in a solid state, and that the reaction could not be carried out in practice because of the slowness of reaction rate necessitated by these conditions. The free energy of FeO calculated from the composition of the samples prepared during this work, as well as that calculated from Tritton and Hanson's work, has been shown to agree well with equilibria measurements of FeO at lower temperatures, especially when the discrepancies in the existing data for specific heats and heats of formation and the further lack of data on the heats of fusion of magnetite and ferrous oxide are considered. Should these latter data become available, the concordant nature of the results secured might enable accurate and critical free energy calculations to be made in this temperature range.

Miscellanea.

A VERY rich lode of tin ore is said to have been found on the Mutue Fides property, Transvaal.

THE Umtali (South Africa) Council proposes to expend £53,000 on extending its electricity supply scheme.

A LARGE foundry and engineering works is to be put up at East London, South Africa, by E. G. Dowse and Co.

A BORE-HOLE drilled near Lloydminster, Saskatchewan, is blowing off gas at the rate of about 30 million cubic feet a day.

A GREAT bed of salt has been found by drilling at Waterways, Alberta. It is 670ft. beneath the surface and is over 200ft. thick.

DURING the last year for which statistics have been published, the tramway undertakings of Great Britain carried 4700 million passengers.

THE cold storage accommodation on the Union Castle liners plying to South Africa is being practically doubled for the purpose of carrying fruit.

A SEAM of good steam coal is said to have been found, outcropping, about 50 miles from Lourenço Marques, and some 20 miles from the main railway line.

A RICH vein of gold has been discovered in the Midlands of Rhodesia, while another, said to pan as high as 12 dwt. to 15 dwt., has been found near Que Que.

A PLANT for the production of 300 lb. of solid carbon dioxide per hour has been put up at Acton for T. Wall and Sons, by Sparklets, Ltd., of Edmonton.

ARRANGEMENTS are being made for the development of the coalfield on the borders of Cumberland and Northumberland in the neighbourhood of Bampton.

THE efforts to reduce the pollution of the river Tees have proved so satisfactory that the catch of salmon has increased by about 50 per cent. during the last year.

THE new Chrysler motor car factory at Walkerville, Ontario, is to cost 2,000,000 dollars. It is to have five storeys with a total floor space of 500,000 square feet.

THE opening of the transmission line between Baslow and Grindleford practically completes the electric distribution scheme of the Derwent Valley area of Derbyshire.

THE Canadian Pacific Railway bridge over the Don Valley, between Toronto and Montreal, has been replaced by a heavier structure. It is 1150ft. long and has thirteen spans.

THE drying plant at the Eynsham beet sugar factory, having been extended very considerably, work is now going forward on the drying of 30,000 tons of beet by the Oxford process.

A HYDRO-ELECTRIC power plant of 80,000 horse-power is to be constructed on the Pen d'Oreille River, British Columbia, at a point near the International boundary. It will supply the Trail smelting plant.

A CONTRACT has been placed by the Johannesburg Municipality with a local firm for the supply of from 10,000 to 20,000 loads of road metal per month. The company's plant is capable of crushing some 1500 tons of stone per day.

THE British Government recently sent delegates to an International Conference which opened in Paris to discuss the limitation and regulation of the number of international exhibitions and to conclude an international Convention on the matter. The main object is to limit the long period general exhibition. The British Government takes the view that the short period trade exhibition or fair stands in a different category and in the main is a valuable aid to business.

A CONTRACT has been awarded to Sir Robert M'Alpine and Sons, of London, for the No. 3 section of the Mersey Tunnel. This contract amounts to between £700,000 and £800,000, and covers the construction of the full-sized tunnels on the Birkenhead side of the river, from the Morpeth branch dock shaft to the portals at Albion-street and Rendel-street respectively. No definite date has yet been settled for a start on the work, but it is expected that the arrangements will be completed shortly.

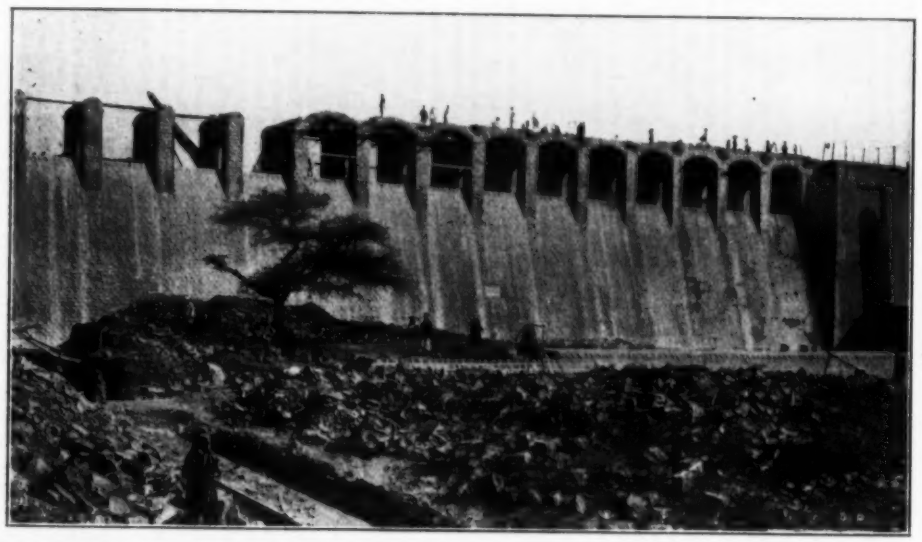
THE Middlesbrough Corporation has completed arrangements whereby electricity consumers can be provided with wireless battery eliminators on a preliminary payment to the Corporation of £1, with half-yearly payments of £1, completing the purchase in five years. According to the *Wireless World*, the device has been designed by Mr. R. H. Scotson, borough electrical engineer; it can be plugged direct into an ordinary lamp socket, and will feed the anode and filament circuits of any kind of valve set. The Corporation is manufacturing the eliminators itself.

A MOTOR lifeboat which the Royal National Lifeboat Institution has built for Cromer left the building yard at Cowes last week, and is on her way by sea to her station under the command of the eastern district inspector of lifeboats, Captain Carver, with Coxswain Blogg and a crew of Cromer lifeboatmen on board. She is a boat of the Watson cabin type, 45ft. 6in. long, with twin screws and two 40 H.P. engines, a cabin searchlight and line-throwing gun. Her speed is 8 knots and she will be able to carry out services at a distance of over 60 miles from her station. The new lifeboat has been built because the old one was severely damaged in rendering service to the Dutch oil tanker "Georgia" just a year ago.

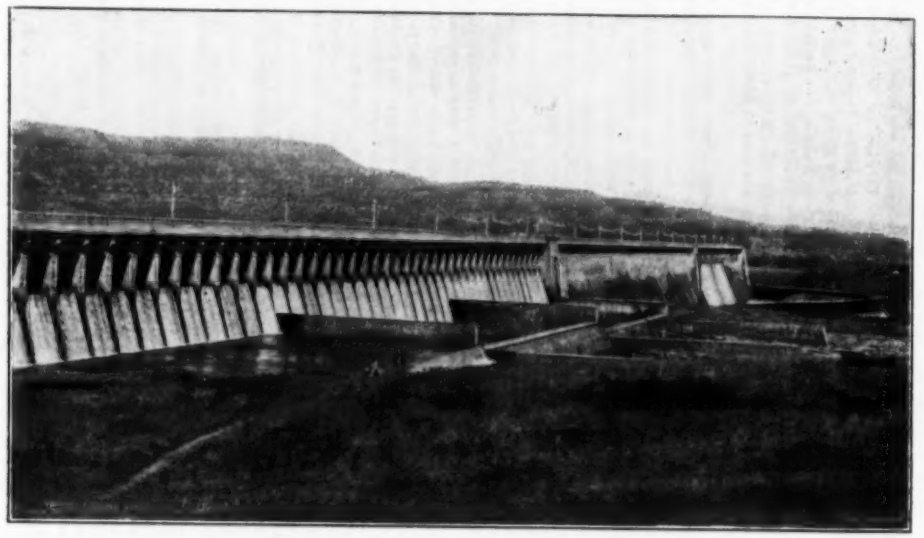
NEGOTIATIONS are being pressed forward between the General Post Office and the telephone administrations of the eighteen European countries with which Great Britain is in telephonic communication for the establishment of a person-to-person service. The advantages of such a service are already available to subscribers, whether in America or Europe, who use the Transatlantic telephone system. It means that in the case of a subscriber desiring direct communication with another subscriber the telephone operators will, if the necessary information is given them, endeavour to find the person wanted if he should not be at his own address when a call is made. At present about 3000 calls are made daily between London and the Continent.

THE LLOYD DAM AT BHATGAR IN THE BOMBAY DECCAN

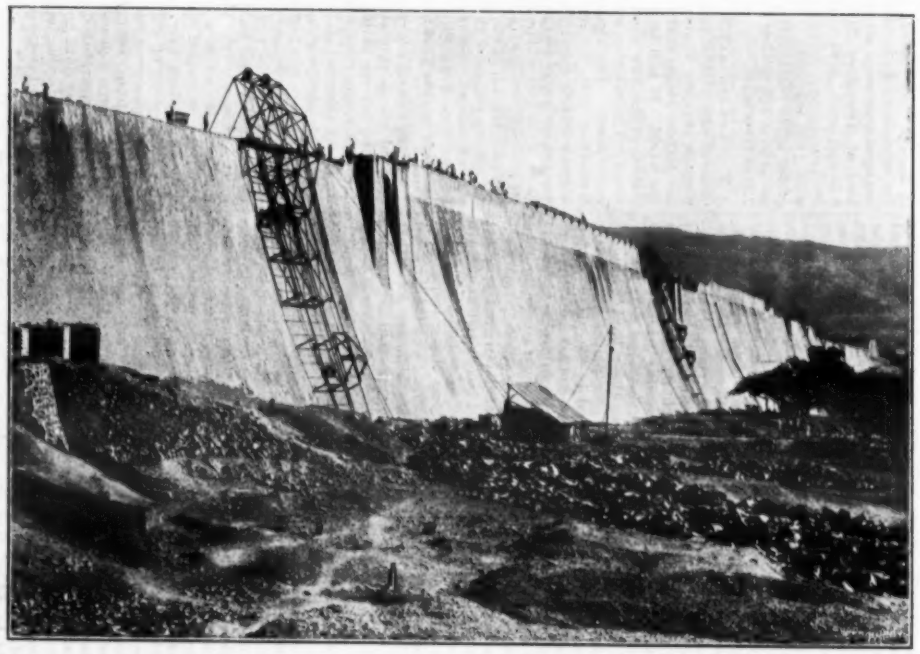
(For description see page 607)



NORTH END OF MAIN WASTE WEIR, SUBSIDIARY WEIR IN FOREGROUND, APRIL, 1925



DOWNSTREAM VIEW OF COMPLETED WASTE WEIR



DOWNSTREAM FACE OF DAM, SHOWING ELEVATORS, APRIL, 1925

PIER MASONRY OF WASTE WEIR AT SOUTH END, APRIL, 1924

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The Metallurgist.

THE NOVEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

DEATH.

On November 20th, 1928, at Durban, Natal, Charles James Crofts, M. Inst. C.E., youngest son of the late William Crofts, Barrister-at-Law of the Middle Temple and Bedford.

THE ENGINEER.

NOVEMBER 30, 1928.

The Gas Lighting of Trains.

We have no desire to minimise the horrors of the fire in the wreckage of the mail train at Charfield on October 13th, nor to appear to justify in any way, or to support, the retention of gas-lighted carriages on trains. It does, however, seem desirable that the true facts should be known, and it is a pity that when, on November 12th, Viscount Curzon, on behalf of the Ministry of Transport, was answering a question on the subject, his reply, whilst quite correct, did not go further. After quoting Colonel Ashley as having shown on November 8th, that railway companies were gradually substituting electric light for gas, and that the risks arising from the use of the latter had not been held to warrant its absolute prohibition, the answer proceeded to deal with the second part of the question. Mr. Morrison had asked whether, prior to the Charfield accident, there had been, within recent years, any railway collisions which had been followed by fire caused by gas? The reply on that point was that during the last five years there had been only one such case, and that no persons were injured by that fire. Lord Curzon did not add as he might have done that in the case in question a rail motor ran into a train of empty carriages; the gas pipe in the brake van of the latter was fractured, and the escaping gas was ignited by the lighted tail-lamp on the brake, which was also broken. In reporting on that accident Colonel Sir John Pringle merely mentioned the fire in the last six lines of his report, and said that it was quickly extinguished. He added that the carriage stock in question was all constructed prior to 1901, and before the date on which electrical lighting was determined upon by the Great Western Company.

Whilst admitting that Mr. Morrison's question was fully answered, it must be acknowledged that an excellent opportunity to reassure the public mind on this subject was neglected. There have been some very serious accidents of this nature in the past. In the first fifteen years of this century there were fourteen cases in which fire broke out in the wreckage—not always, be it noted, owing to escaping gas. The list is as follows:—1905: January 19th, Cudworth; September 1st, Witham. 1906: September 19th, Grantham. 1908: November 27th, Guthrie. 1910: December 24th, Hawes Junction. 1911: July 28th, Crewe. 1912: January 29th, Washwood Heath; April 5th, Eaglescliffe; September 17th, Ditton. 1913: September 2nd, Ais Gill. 1914: April 14th, Burntisland. 1915: March 18th, Smithy Bridge; May 22nd, Quintinshill; December 17th, Jarrow. There was also an escape of gas after the derailment of January 4th, 1906, in Catesby Tunnel, but no fire followed. The first serious accident in which gas-lighting figures prominently was that at Hawes Junction, and, as related and illustrated in The Engineer of December 5th, 1913, the Midland Railway began after it to fix a special valve to the gas cylinders, and to house them in a safer position in the underframes; double-acting, shock-absorbing buffing arrangements were also provided to minimise the effects of collisions. Gradually also the substitution of gas by electric lighting was undertaken by all the companies. Concurrently, there has been a very extensive use of track circuit in signalling, and thereby the number of collisions has been reduced. The net result in this particular matter is that from the end of 1915 to the date of the Charfield accident—a period of practically thirteen years—there were only six fires in trains after accidents. They were: 1916: September 2nd, Warminster. 1918: April 15th, Newby Wiske. 1919: June 16th, Acton Bridge. 1924, April 26th, Euston; November 3nd, Lytham. 1927: October 7th, Old Oak Common. It should be added that after the collision of May 10th, 1926, at St. Margaret's, Edinburgh, there was a very serious escape of gas, but no fire. The incident at Euston was caused by lighted drops of naphtha which fell from the flare lights used in rescue work, and, Sir John Pringle reported that there was "no ill result from the use of gas as an illuminant." The fire at Lytham, again, arose from the derailed train destroying the signal-box, and one of the coaches coming to rest on the contents of the signalman's fire. The Old Oak Common accident was that referred to in the reply of Viscount Curzon on November 12th. Our review does not, however, end with this recital of the cases in which an accident was followed by fire. We may mention, also, no less than eight cases during the same thirteen years since 1915, regarding which testimony was actually borne in the accident reports to there having been no ill-effects from the use of gas; in dozens of other cases, similar remarks could also have been made. On December 19th, 1916, the West Coast sleeping car train ran into the Windermere mail at Wigan, and near Kirtlebridge, on the same morning, the down "Postal" caught up and collided with a freight train. In the former it was reported that there was no sign of fire in the wreckage, and whilst in the latter six out of the ten passenger vehicles were gas lighted, "none of the gas fitments on the train appeared to have been injured, and none of the wreckage caught fire." On October 6th, 1919, a collision occurred at Carstairs, in which one train had eight coaches, all gas lighted. The gas fittings in one vehicle were damaged, but there was "no fire among the *débris*." In the head-on collision of July 17th, 1920 at Lostock Junction, the two trains concerned had gas in thirteen out of the total of fourteen carriages but there was no fire in the wreckage, although the gas fittings, &c., were displaced in several coaches. In reporting on the yet more serious head-on collision of January 26th, 1921, at Abermule, Sir John Pringle said on this subject: "It will be noticed that nine of the thirteen coaching vehicles were gas lighted, but, fortunately, no fire started in the wreckage, nor was any evidence found of explosion due to escaping gas." A buffer-stop collision occurred at Glasgow Central on January 24th, 1925, where "although certain fittings were destroyed, there was no evidence of escape (of

gas) "; and in the serious collision at Hull on February 14th of last year it was recorded that although so many of the vehicles were fitted with gas lighting, no fire arose in the wreckage. Then, lastly, there was the head-on collision of October 31st, 1927, at Ware, when the four leading coaches on one train were smashed beyond repair, and the two leading vehicles on the other train were telescoped. All fifteen coaches were fitted with gas and had their lights on, but there was no ill-effect.

Despite, then, the terrible results of the Charfield disaster, we trust we have shown that the case was very exceptional, and that Colonel Ashley may continue to say, as he did on November 8th, in the words quoted above, that "the risks arising from the use of gas have not been held to warrant its absolute prohibition as an illuminant in railway carriages." But the causes that made the use of gas desirable in the past have disappeared. It came in as the natural sequence to the miserable oil lamps, which were not so much sources of illumination as devices for revealing the gloom of railway compartments at night, and by its help carriages were really well lighted; indeed, it may be said that even to-day gas-lit trains are frequently more brilliantly illuminated than those lit by electricity. But just as electricity is displacing gas for lighting in houses, owing to its convenience, so it is coming in steadily on railways, and in the course of time all the gas-lit stock will have disappeared, as none is being built to replace that which goes out of use. According to the Railway Returns, out of the 5576 new or rebuilt carriages put into service during the four years 1924-27, all but twenty-six were provided with electric lighting.

Locomotive Fire-boxes.

Of all the parts of a steam locomotive, none has a more interesting history than the fire-box. It has been the subject of endless invention and many heart-breaking experiments, and to this day, when it has reached apparent stability, it continues to present problems of a very practical nature. It has often been said, in the past, "Give me a big enough boiler and you may put what engine you like under it." But if the boiler is the heart of the whole locomotive, the fire-box is certainly the heart of the boiler. It is not surprising, then, that it has a lively history. It began with the "Rocket." There are still some doubts about the precise arrangements of the fire-box at the Rainhill trials; but, at any rate, it was a water-lined box and the prototype of all fire-boxes in common use up to the present day. Stephenson's fire-box was a separate part attached to the back of the boiler, but in a very few years the firm had incorporated it in the general structure, and so it has remained to this day. Its actual form is modified in a variety of ways, but substantially it is now what it has always been, an inverted lidless box surrounded on five sides by water.

It is these sides that have always presented the trouble, as they must be plentifully stayed in order to resist the heavy external pressure put upon them. As pressures grow higher and higher, this problem increases in magnitude, and the time must inevitably come when the fire-box as we have known it for a hundred years will disappear. We shall see the flat walls replaced by water tubes, left bare as in the familiar Brotan type, or buried in refractories as in some modern water-walled furnaces of large stationary boilers. It is possible that the plain refractory walls will also be revived once more, in conjunction with water-tube boilers, if the research into fire-brick leads to the discovery of one which will stand the heat, for the temperatures which may be attained in the fire-boxes of locomotives are very high indeed. We have had access to a couple of very interesting letters on this subject, written recently by Mr. William Palmer, of Sydney, Australia, to Sir Henry Fowler, and on another page we give extracts from them. Sir Henry, it may be recalled, asked Mr. Lawford Fry in the discussion on a paper which he read before the "Mechanicals" a few months past what his views were on a brick-lined fire-box. Mr. Fry had no experience, but Mr. Palmer has been able to supply some facts which are worth putting on record. The experiment was made thirty years ago by Mr. T. F. Rotherham, who was then Locomotive Superintendent of the New Zealand Government Railways. The particulars of the changes which were made in a locomotive to carry it out are described in Mr. Palmer's letter. We need only say here that the boiler barrels and the tubes were lengthened by three feet and the fire-box shell plate by one foot. The box was then lined inside with fire-clay blocks attached by bolts, the heads of which were buried in fire-clay. After these changes the engine "steamed like a witch," and the experiments might have been a success were it not that the heads of the bolts were burnt off and the fire-door baffle was destroyed by the heat. An additional trouble which must be borne in mind by anyone who thinks of using a brick-lined furnace, was that the engine continued to steam long after it had been put to bed, and a nurse had to sit up with it all night watching the feed! In another letter, from which we also make some extracts, Mr. Palmer gives some account of the employment of the copper fire-box in New Zealand and Australia. It will be noted that whilst the steel fire-box is used, a copper tube plate is employed with it. The one-time mystery of the steel box has practically disappeared, and there is nowadays relatively little difficulty in obtaining a suitable steel. But there is no appreciable advantage saving in first cost—the old copper boxes commanding a good price—and unless British railways take to steel in order to encourage the British steel industry, it is not likely that we shall see a great extension of the use of copper boxes in this country.

Unquestionably, the most interesting point about the locomotive fire-box at the present moment is its future. With the imminent arrival of much higher pressures in locomotives, the normal type of box, if not the whole boiler, is doomed. The box with walls composed of vertical water tubes is at present the only alternative, but he would be a rash man who asserted that it is the only valid solution. To take but one other possible design, we may mention the cylindrical box, which would probably lend itself well to liquid or powdered fuel combustion. But the problem is mixed up with many others connected with very high pressures, and cannot be dissociated from them. Some attention is being given to the subject in this country, but, we must admit with regret, greater efforts are being made in Germany and Switzerland than here. Whilst there is so far not a single extra-high pressure British locomotive, at least two foreign engines have been running for some time and another is under construction. Let us hope that before another year is out we shall see an all-British super-pressure locomotive on the road.

Ten Years of Reconstruction in Belgium.

No country suffered more, in a material sense, from the Great War than Belgium. During four years all but an insignificant portion of the kingdom was in the hands of the enemy, who destroyed the economic fabric without pity and deported many of the workers, their action being often unjustifiable by any pretence of military exigencies. Ten years have now passed since the Belgians recovered what was left of their property, and in the "Bulletin de la Mutuelle Solvay" is an interesting account of the resuscitation of industry which has taken place during this decade.

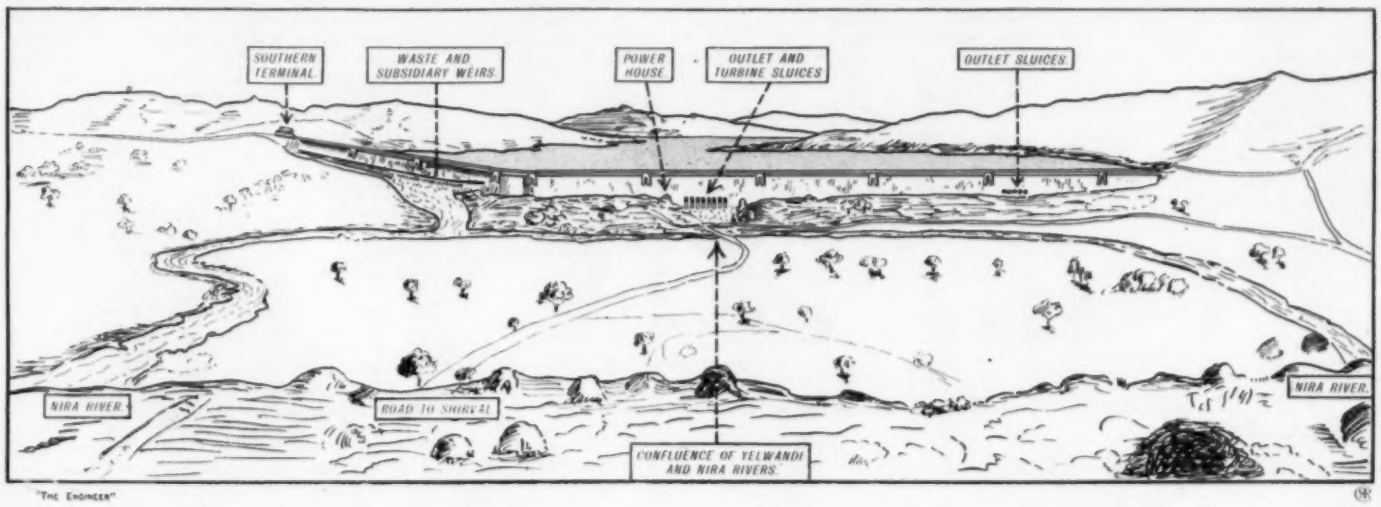
At the end of the war more than 2000 kiloms. out of the 9000 kiloms. of Belgian railways had been rendered useless, and hardly any of the signalling apparatus on the densest railway system in the world remained. On August 1st, 1914, the Railway Department possessed 4513 locomotives, of which 85 per cent. were in running order; on December 1st, 1918, no more than 181 locomotives were usable. Of the fifty-seven blast-furnaces existing before the war, eleven only remained intact at the end, twenty-six being completely destroyed and twenty partly so. In the steel works of the province of Hainaut, where twenty-four Bessemer basic converters were in service, sixteen were completely wrecked and the rest damaged; in the same works several months after the Armistice it was only possible to render six rolling mills usable out of the forty-eight which existed before the war. The steel works in the province of Liége suffered in like degree, twenty-nine rolling mills out of fifty-three being destroyed and three seriously damaged. The coal mines were injured very little, although of the 2554 coke ovens existing before the war less than a thousand were left undamaged by the enemy. The chemical industry suffered specially from the destruction of the lead chambers required for sulphuric acid manufacture, five works only out of twenty-seven being able to restart immediately after the war. We need not mention the destruction and sacking of central stations and machine shops, the killing or carrying away of half the horses and cattle, the damaging of roads, canals, bridges and other necessities of industry and agriculture, to confirm the fact that so far as international trade was concerned Belgium at the close of 1918 was "down and out."

The history of the last ten years is that of an economic effort as honourable and indefatigable as the military effort which preceded it. The Belgians are not only an industrial, but an industrious nation, and have had the good fortune to be led by men of vision during the critical period of reconstruction. The full effect of the commercial evolution which has taken place has not yet had time to be felt; indeed the evolution itself, with its rationalisation of industry under the guidance of powerful banks, has by no means reached its final stage. Nevertheless, the country is already highly prosperous, order books are full, and unemployment is negligible. The completeness of the recovery from the effects of the war may be shown by a few figures. In 1913 the Belgian railways carried 66·5 million tons of merchandise, in 1927 the figure was 76·6 tons. The shipping entering Belgian ports has grown from 11,505 vessels, aggregating 16·9 million tons, to 18,684 vessels, aggregating 27·8 million tons, in the same time. The coal mines, which produced 22·8 million tons in 1913, were, as has been mentioned, not much damaged during the war; but at its conclusion the poor physique of such miners as returned and the shortened working hours considerably reduced the output. The use of mechanical coal cutters and other apparatus, however, was greatly extended, and the production which was only 18·4 million tons in 1919, rose to 27·6 million tons during 1927. Coke making recovered slowly, but none the less effectively. The output of 3·5 million tons during 1913 was down to 0·7 million tons in 1919, but rose to no less than 5·4 million tons last year. The number of coke ovens is only slightly greater than before the war, but improvements in design and equipment have raised the output by something like 70 per cent.

In the metallurgical industry a similar tale is to be told. The number of blast-furnaces now in use is practically the same as before the war, yet the output of pig iron has increased from 2·5 million tons in 1913 to 3·7 million tons last year. As regards finished steel the progress is even more striking, the output of 1·9 million tons of 1913 having grown to 3·1 million tons for 1927. The production of zinc, which fell from 204,000 tons in 1913 to 20,000 tons in 1919, has now just about returned to the pre-war figure. Copper, of which Belgium produced about 1000 tons in 1913, was manufactured to the amount of over 27,000 tons in 1926, the growth of this industry being principally due to the rich ore deposits in the Belgian Congo. Mineral from the same Colony makes Belgium for all practical purposes the only radium-producing country in the world.

Belgian glass works produced in 1913 41·7 million square metres of ordinary glass. In 1927 the output was 54·7 million square metres, or 131 per cent. of the pre-war quantity. The plate glass industry, which depends upon export trade for 95 per cent. of its output, exported 38,400 tons in 1913 and 60,000 tons in 1927, the capacity of the plants having been increased by 33 per cent. during the same period. The textile mills, except such as were in the zone of military operations, did not suffer much from the war, the taking away of belting, electrical apparatus and raw material being about the extent of the injuries experienced. The cotton mills, which possessed rather over 1¼ million spindles, had increased their capacity to nearly 2 million spindles by the end of 1927. The production of cotton yarn increased from 45,400 tons in 1913 to 65,150 tons in 1927. Exports of cotton piece goods increased from 28,187 to 38,591 tons in the same period, and exports of woollen goods from 1957 to 3396 tons. Turning to other industries, the production of sulphate of ammonia is said to have passed from 48,000 tons in 1913 to 80,000 tons in 1927, and that of sulphuric acid from 580,000 tons to 770,000 tons. These figures, however, are unofficial. The Portland cement industry, which had an annual capacity of 1·5 million tons before the war, now has a capacity of 2·9 million tons. Finally, we may cite the central station industry. The installed capacity of the non-municipal stations rose from 131,000 kW in 1913 to 780,000 kW at the end of 1926. It is a pity that no later figures are given, for the electrical development during the last two years has been very great. A supply of electricity is now available in com-

THE LLOYD DAM AT BHATGAR IN THE BOMBAY DECCAN



munes comprising two and a-half times the population served in 1913, and the consumption per inhabitant, which was 69·1 kWh in 1913, reached 203 kWh in 1927.

The facts we have cited are sufficient to show that, within ten years of a catastrophe which overwhelmed the entire nation, the Belgians have been able, not only to reconstruct the whole of their industries, but also to raise their productive capacity far above the pre-war level. The national finances are as sound as those of any country in the world, and the kingdom is enjoying a prosperity justly earned.

SIXTY YEARS AGO.

In this paragraph about a month ago we referred to the Heaton process for converting pig iron into steel. That process, it may be recalled, consisted of tipping a charge of molten pig iron on to a certain weight of crude nitrate of soda. Complicated internal reactions ensued, the result of which was to leave, after a period of seven or eight minutes, a material which, on cooling, had a crystallo-fibrous structure and which was stated to resemble malleable iron of the very purest and finest quality. In giving particulars of the process we stated that it had been in successful commercial operation for some time at the Langley Mill Works, near Nottingham, and quoted the very favourable opinions expressed by Dr. Miller and Mr. Robert Mallet regarding the quality and uniformity of the product. In preparing our note we were struck by the fact that the writer who described the process in our columns sixty years ago gave no information as to the amount of nitrate of soda required to convert 1 ton of molten pig. Others at the time also noticed the omission, particularly Mr. Septimus Piesse, F.C.S. In a letter from that gentleman which we published in our issue of November 27th, 1868, it was stated that Heaton's idea was not new and that it had been tried by Bessemer himself a long time previously. It was not a practicable process, according to Mr. Piesse, because even supposing all the available oxygen was used it would require 15 cwt. of nitrate of soda to "blow" a ton of iron. Taking the Barrow Hematite Company as an example, he said that its weekly output of 720 tons of iron, if produced by the Heaton method, would require the use of 540 tons of nitre. At £5 a ton for the nitrate the process would clearly be "utterly impracticable." We communicated Mr. Piesse's remarks to the owners of Heaton's patent. In their reply they charged him with writing discourteously and dogmatically on a subject about which he obviously knew very little. His argument, it seemed, was based on the assumption that because Bessemer used so many cubic feet of air per ton of iron it was necessary in the Heaton process to employ an amount of nitrate of soda containing an equivalent volume of oxygen. That was the argument, it was said, of one who was neither "a practical man nor a good theoretic chemist." The proportion of nitrate of soda habitually employed so far by Mr. Heaton was 2 cwt. per ton of crude iron converted. There was every ground for believing that that proportion was in excess of what was necessary and of what would later on be employed when the complex reactions taking place in the Heaton converter were completely understood.

Work will be commenced at once on the construction of a branch line of railway, from the recently completed northern Manitoba Railway, usually known as the Flin Flon Branch of the Hudson Bay, to the copper property of the Sherritt-Gordon company at Gold Lake, Man., a distance of 42 miles. Under an agreement between the promoters of the company and the Canadian National Railways, which will operate the line, the company gives a cash guarantee, 1,500,000 dollars, for the construction of a concentrator, and other works for the development of the property on a large scale, and also gives a cash bonus of 125,000 dollars for speedy completion of the work. The line will be built by the Dominion Construction Company of Winnipeg, the construction of the Flin Flon line by which within ten months was regarded as a notable engineering feat. It is expected that the work will be finished by December of next year.

The Lloyd Dam at Bhatgar.

As we announced at the time, the great Lloyd Dam at Bhatgar, in the Bombay Deccan, was formally put into service on October 27th last by his Excellency the Right Hon. Sir Leslie Orme Wilson, the Governor of Bombay. We had previously given some particulars and illustrations, reproduced from photographs, of this important undertaking, and now, by the courtesy of the Director of Information, Government of Bombay, we are enabled to give, in what follows, some further information regarding the Dam and the irrigation scheme of which it forms an integral part, and also to give reproductions of some additional photographs and drawings.

In a brochure, which was prepared for the opening ceremony, it is pointed out that irrigation works in the Bombay Deccan are fundamentally different from those in Sind, the Punjab, Egypt or Mesopotamia, where wide alluvial plains have been formed by very large deltaic rivers in perennial flow. The Bombay Deccan consists of a sloping tableland running eastward from the ridge of the great geographical feature of Western India—the Western Ghats, which form a ridge running parallel to the sea coast at a distance from it of from 50 to 100 miles. The mountains are precipitous on the western side, but they fall away more gradually to the east. The heaviest rainfall occurs on the peak of the Ghat ridge, where anything up to 250in. or more of rain may be recorded in the four monsoon months. To the eastward the intensity of the rainfall decreases very rapidly so that at a distance of from 100 to 150 miles from the Ghats the precipitation has fallen to from some 20in. to 25in.

The rivers in the Bombay Deccan rise in the valleys close to the ridge, flow in an eastward direction, and are dry, or practically dry, for seven or eight months of the year. The line of the Ghats divides the rainfall into two parts: one, the smaller portion, draining westward into the Indian Ocean, and the other flowing, through long lengths of tortuous rivers, to the east, and joining the rivers which reach the sea on the south-east coast of the peninsula. These rivers are in flow during the monsoon months only, and if no artificial means of conserving their waters were provided the whole monsoon would be wasted—so far as the Bombay Deccan is concerned—and would simply flow away to the sea, benefiting to but a small extent the country traversed.

The Lloyd Dam, which was designed by Mr. C. B. Pooley, Executive Engineer, and which submerges an older dam at the same place to a depth of 60ft., was built to increase the storage at this point to some 24,200,000,000 cubic feet, and the water thus held up is being employed to supply both the Nira Right Bank and the enlarged Nira Left Bank irrigation canal systems. The dam has been constructed across the valley of the Yelwandi River near its confluence with the river Nira. A general view of it is given above, while Fig. 1 gives an outline of the irrigation scheme and shows the canals and areas protected.

In order to make this article complete in itself we repeat the leading particulars of the dam. The structure has a length of 5333ft., a maximum height above the lowest foundations of 190ft., and a maximum width at the base of 124ft. The maximum depth of water above the lowest sluices is 143ft. The volume of masonry reaches the enormous figure of 21½ million cubic feet, which is 3½ million cubic feet greater than that of the masonry in the Assouan Dam, and is said to be larger than that of any other dam hitherto built. By way of illustrating what this volume means it is pointed out in the brochure from which we are quoting that if the masonry were employed to build a wall 6ft. high and 15in. thick, the wall so formed would be over 520 miles long. The lake constituted by the dam has a length of 17 miles, a perimeter of 46 miles, and a surface area of 14·7 miles, which is nearly as large as that of the Isle of Bombay. The volume of water impounded at top water level is 24,198 million cubic feet. This volume, it is pointed out, would submerge to a depth of 1ft. an area of 555,510 acres, or 868 square miles. These figures are somewhat hard to grasp, but an idea of the volume of water held up may be obtained from the fact that the whole of the Isle of Man would be covered by it to a depth of nearly 4ft.

The sketch given in Fig. 2 illustrates the arrangements for letting out water for irrigation as the level of the lake falls. Gates are fitted to the waste weir for regulating and controlling the flood level in the lake. There are eighty-one gates, each measuring

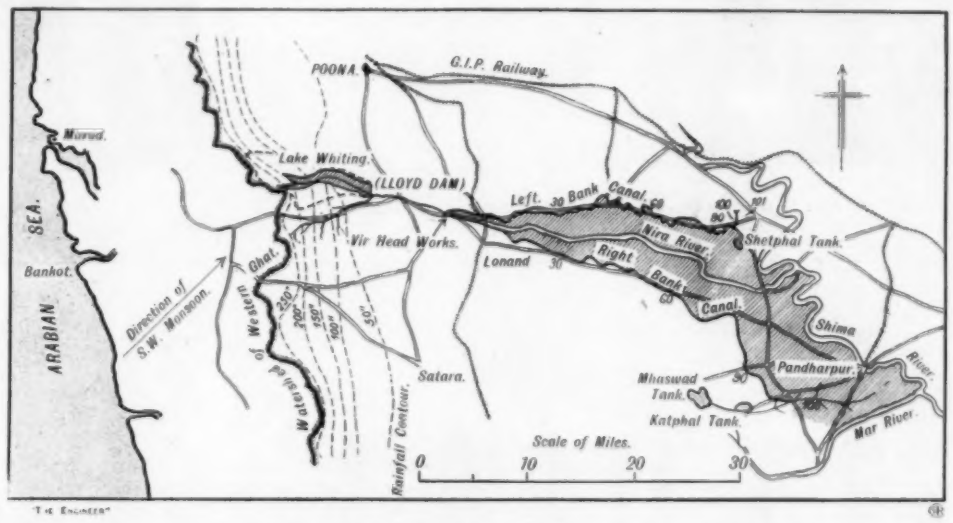


FIG. 1—SKETCH PLAN SHOWING BOMBAY DECCAN IRRIGATION SCHEME

10ft. by 8ft., forty-five being of the automatic and thirty-six of the rolling type. The automatic gates are connected to counterweights by chains passing over pulleys. When a counterweight is suspended in air its weight is 1000 lb. more than that of the gate, and the gate is held up; but when it is submerged its weight becomes less than that of the gate by some 1000 lb., and the gate falls. Consequently, when the water rises above F.S.L. in the lake it flows through openings in the masonry which connect with the counterweight chambers, and as the latter fill the effective weight of the counterpoises is decreased, the gates fall, and the water discharges over their tops. There are small drains in the counterweight chambers which allow the water to drain off when the level of the water in the lake has fallen sufficiently, and when the chambers are emptied of water the counterweights overcome the weights of the gates and pull the latter into the closed position.

The dam is constructed entirely of rubble masonry in lime mortar. For the main bulk of it trap rock of excellent quality was obtained from quarries in the vicinity, but for the face work special rock of great durability, called "Kar Boulder Stone," was selected from distances up to 10 miles away. The transport of materials—stone and mortar—was effected by 24 miles of light railway and by a steam launch with six large barges for bringing materials from the shores of the lake.

Hydraulic lime was burnt from specially selected limestone at depôts situated 12 to 25 miles distant and was transported by carts and motor lorries to the site of the works. Natural sand was not obtainable in the vicinity, so trap stone was crushed to make sand and it and the lime were mixed together at the site by power-driven mills to form the mortar. To obtain the power necessary for this and other purposes, advantage was taken of the water held up by the old Bhatgar Dam to develop electrical energy, and the whole of the plant on the works was driven by alternating current at 2000 volts.

As the dam increased in height it became necessary to devise means for raising the materials, since, on account of the great length of the dam, they could not be run on to the work from each end. To cope with this situation Mr. C. B. Pooley devised special electrically operated elevators, which could be raised as the work proceeded. Two of these elevators are seen in one of the engravings on page 604.

The plant was laid out to enable 15,000 cubic feet of masonry to be put in position daily. The sand crushing and mortar crushing machines were arranged in four batteries, each consisting of ten mortar pans and two sand crushing plants, the whole being electrically operated. In order to keep the plants in proper running order, a workshop and foundry were established with most satisfactory and economical results. It is calculated that the use of hydraulically produced electric power instead of coal or oil effected savings which more than paid for the entire cost of the installation.

The power-house, which was constructed to provide the energy necessary for this and other purposes, contains four units, each of 256 kilowatts. The turbines are of the Francis mixed flow reaction type designed to work with heads of water varying from the greatest to the least depth of water occurring in the lake at different seasons. Regulation is effected by oil pressure governors, which can, in the case of breakdown, cut off the water from the unit affected in 10 seconds. The turbines are directly connected through flexible couplings to 2000-volt, 50-cycle, 3-phase alternators.

Work on the Dam was first started at the end of 1912, and the amount of work to be done annually was decided according to a programme so arranged that water would be available when required by the canals, since canals and their distributing systems, which extend over a very large area of country, take very much longer to construct than does a masonry dam, which might have been finished much earlier than it was had it been necessary. The excavations for the foundations were fairly straightforward, except in the river bed itself, where a bad patch of red rock was encountered which entailed going down to 40ft. below ground level. A spring also gave trouble, and an outlet had to be made for it so as to avoid the danger of upward pressure under the base of the dam. A particularly difficult matter, during the progress

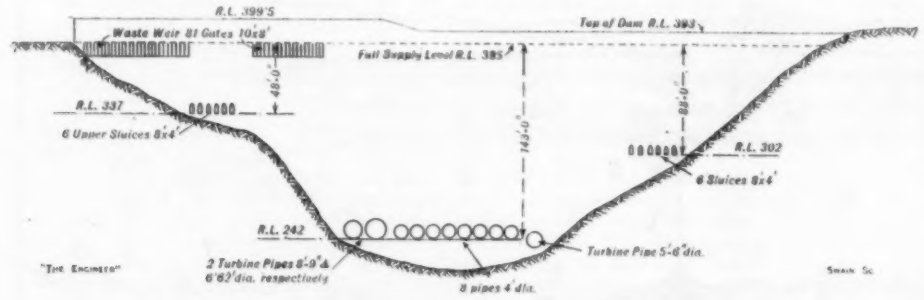


FIG. 2—DIAGRAMMATIC SKETCH OF DOWNSTREAM FACE OF DAM

FIG. 3—UPSTREAM SIDE OF DAM LOOKING SOUTH

FIG. 4—VIEW LOOKING NORTH ALONG THE DAM

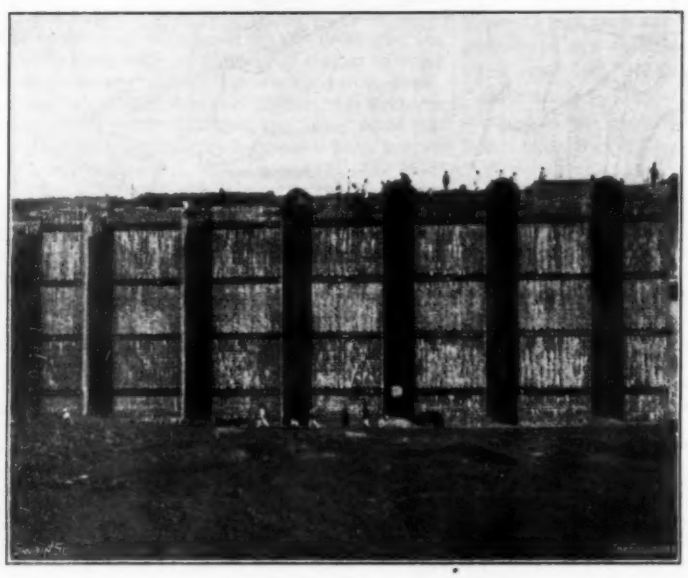


FIG. 5—SOUTHERN IRRIGATION SLUICES—UPSTREAM VIEW

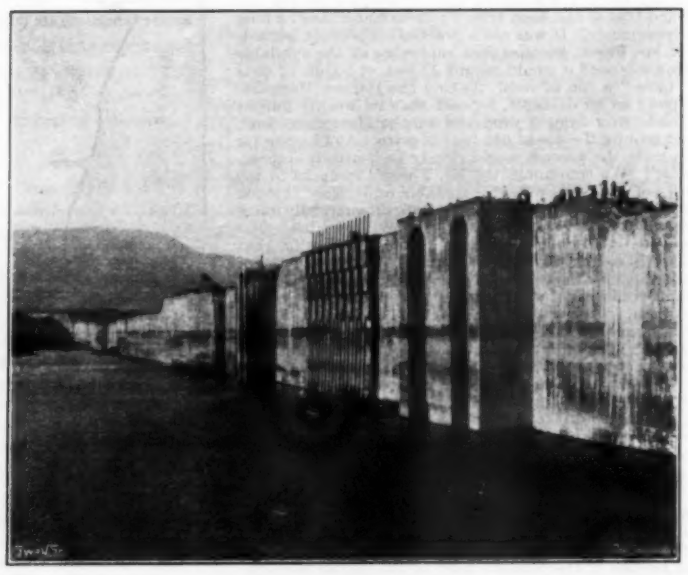


FIG. 6—UPSTREAM VIEW SHOWING SLUICES AND TURBINE PIPE BUTTRESSES

of the work, was that of arranging for water for the canal and for passing a supply over the foundation trench of the Dam. A great deal of water was met with in the foundations, and had to be pumped out. Certain fissures and dykes were also encountered in the foundation trench, which required special care and treatment. Up to as many as 5000 men were employed on the work, and special labour camps and a bazaar with a police force to maintain order had to be established. In the early years of construction the Great War affected progress very considerably. An aerial ropeway for conveying lime 24 miles from Diva beyond Purandhar had to be abandoned entirely, and electric plant from Switzerland, which was captured at Antwerp but eventually retaken and

FIG. 7—EXCAVATION AND MASONRY FOR SUBSIDIARY WEIR

re-shipped from Genoa, took more than a year on its journey to India.

In constructing the Dam great care was taken that the materials used were of first-class quality and ample strength. The actual maximum intensity of compressive strength in the structure is calculated to be 245 lb. per square inch on a plane normal to the resultant pressure, and, allowing for a factor of safety of 5, a compressive strength of 1225 lb. per square inch was required for the masonry. The mortar was tested, both for strength and hydraulic properties, during the progress of the work, and the results are reported to have shown that there is an ample margin of strength in excess of that required. The weight of the rubble masonry in the Dam, including that of the lime mortar—1 of lime to 2 of sand—is given as being 164 lb. per cubic foot, as ascertained by actual tests, against 150 lb. as assumed in the calculations for stability, and the weight of the water was taken at 64 lb. per cubic foot to allow for increased weight due to silt in suspension.

In order to ascertain the variations of temperature within the Dam, thermometers, consisting of platinum wires wound on quartz rods, and encased, were built into the heart of the masonry. These instruments, which operate on the principle that the electrical resistance of the platinum wire varies with alterations in temperature, are used to record those variations continuously. The results of observations made with them show that in the centre of the structure the temperature is now practically uniform at 70 deg. Fah. throughout the year, whereas it was 76 deg. Fah. when the masonry was newly laid. Near the face, however, the temperatures vary considerably, and especially is that found to be the case on the downstream face, which is more exposed to the sun than is the upstream face. There the variation is found to be as much as 18 deg.—78 deg. to 96 deg.—at a point 18in. inside the masonry.

In this connection the brochure makes the following comments :—

"The experiments give the following practical results :—(1) In thin masonry walls the variation of temperature and therefore stresses due to temperature are considerable, but in walls of over 10ft. thick the stresses due to temperature are almost negligible ; (2) the materials with which the Lloyd Dam is built have a very low coefficient of expansion, namely, 0·00000370 for trap rock in lime mortar. But in future we may have to build high and long dams in cement concrete, which has a much higher coefficient of expansion—0·00000979—and our experiments show that had we used cement concrete, expansion joints to allow of movements of a quarter of an inch would have been necessary at every 50ft. along the Dam."

The work of construction was carried out departmentally, by petty piecework, under the direct supervision of the executive Engineer, and here we may mention that the following acted in that capacity for various periods during the continuance of the operations :—Messrs. C. B. Pooley, C. G. Hawes, Assoc. M. Inst. C.E., W. A. Evershed, Assoc. M. Inst. C.E., N. B. Baxter, W. H. E. Garrod, Assoc. M. Inst. C.E., J. A. S. Manson, M. T. Gibling, and R. H. Hammett, Assoc. M. Inst. C.E. The plan pursued resulted in great economy, as no contractor had found it possible to tender within the estimated rates, whereas the work was actually done with a saving of some three lakhs of rupees on the estimated cost. When the work was first started a contract for part of the excavation was made with a Pioneer Regiment from Kirkee with excellent results, but the regiment had to leave for active service after a few months. Later, certain criminal tribes were employed and did useful work, though it was found to be rather difficult to handle them at times.

The works have been financed since the year 1918 from loan funds on which interest is payable, and so it was necessary not to expend more money and incur interest charges thereon, till such times as the additional storage could be utilised to obtain revenue from the canals. The working season at Bhatgar is limited to seven or eight months annually, on account of the heavy rainfall during the monsoon months. Many local men who previously had been unskilled workers were trained as masons and fitters, while others were trained to look after machinery of various types. By this training of local men considerable economy was effected, and satisfactory results, much to the advantage of the men themselves as well as to the country at large, was obtained.

At one period during the construction of the work progress was considerably hindered owing to political propaganda by agitators from outside, who, working on the credulous nature of the local populace, induced some of them to resort to passive resistance, and to refuse to allow stone to be removed from their lands and transported to the works. At one time the situation was serious, but luckily there was a sufficient stock of materials on the site to enable the work to be continued for the time being, and the people who did not wish their stone to be removed were told that the stone could remain where it was in their fields, and that arrangements would be made to obtain it from elsewhere. In this matter the Bhor State gave very valuable and loyal assistance by allowing new quarries to be opened up in State lands, and when the local people saw that the stone from their fields was not essential, they soon came to terms and allowed the work to proceed. It may be mentioned here that the cordial thanks of the Government were conveyed to the Chief of this State personally and to his officials for their ready assistance and loyal co-operation at all times throughout the construction of the dam.

Some hardship was inevitable owing to the necessity of acquiring land now submerged by the lake, but great care was taken, throughout, to ensure that full and fair compensation was granted in all such cases. Offers were made of Government lands in the canal tracks in exchange for lands thus acquired, but only a few persons took advantage of such offers, as the majority preferred to remain in their own villages and to accept compensation in cash for their lands and houses. Altogether, thirty-nine villages and 5068 acres of land were acquired, and compensation amounting to 7,18,593 rupees has been paid in cash. The total cost of the dam was 172 lakhs of rupees, or, very nearly, £1,300,000 at the present rate of exchange.

In conclusion, a few words may be said regarding the systems of canals which are supplied with water impounded by this enormous dam. The Nira Left Bank Canal is 100 miles and the Nira Right Bank Canal 106½ miles in length. These two canals command between them 834,104 acres, of which it is estimated that approximately 202,000 acres will be irrigated annually. The Canal Head works are situated at Vir on the Nira River, 17 miles downstream of the dam. During the monsoon months the river flow is usually sufficient, but stored water has to be used for the rest of the year. It is let out through the sluices in the dam, flows down the river bed, and is diverted into the canals by a weir at Vir. A programme of the water required for the crops is prepared and special telegraph and telephone lines are constructed all over the area to ensure correct distribution and to avoid waste of water. The principal crops irrigated are sugar cane, fruit trees, vegetables, bajri, jowari, ground nuts, cotton, &c. To convey the produce to market road communications are being improved and a railway between Lonand and Pandharpur is under construction.

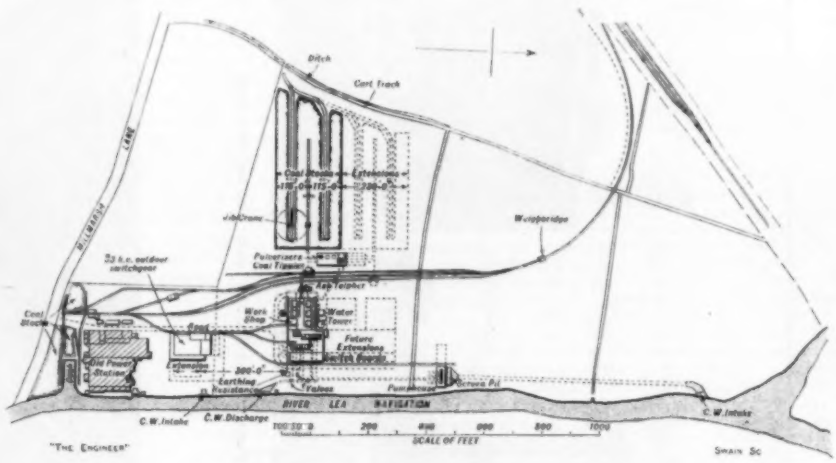
The Canals protect from famine an area that is particularly liable to drought, and the scheme, which is classed as a protective one, is estimated to cost 557·02 lakhs of rupees—over £4,175,000—and to give a net direct return on outlay of 3·02 per cent. The indirect benefits to the country cannot be estimated with accuracy, but the increased productivity of the irrigated area, will be a most valuable asset. The following figures are put forward to give an idea of the tonnage and value of the crops likely to be raised annually :—

		Valued at (rupees).
Sugar cane	780,000 tons	1,95,00,000
Grain	76,000 „	60,80,000
Cotton	1,890 „	10,50,000
Gur	91,863 „	5,64,95,745
Nuts	20,900 „	56,43,000
Fruit	1,100 acres	55,000

To mention the names of all those who have been concerned in one way or the other with this great undertaking would be impossible. It must suffice to say that a tablet in a memorial building at one end of the dam has inscribed on it the names of five "Chief Engineers for Irrigation" ; seven "Superintending Engineers" ; eight "Executive Engineers" ; twenty-two "Sub-Divisional Officers" ; and nineteen "Sub-ordinates."

The New Brimsdown Power Station.

ON Thursday of last week we were afforded an opportunity of inspecting the first section of the new



PLAN OF BRIMSDOWN POWER STATION SITE

Brimsdown Station of the North Metropolitan Electric Power Supply Company. Its present capacity is 50,000 kilowatts, but in due course it is intended to add two other similar sections and two additional boiler-houses, when the capacity will be increased to 150,000 kilowatts. Prior to the erection of this new power house, the company had two main stations, one at Willesden and the other at Brimsdown, Enfield, where the new station—see above—has been built. At the end of 1925, the capacity of the plant at Willesden was 24,500 kW, and that at Brimsdown 23,600 kW, whilst the load on the system during the winter of that year was 49,000 kW. Apart from

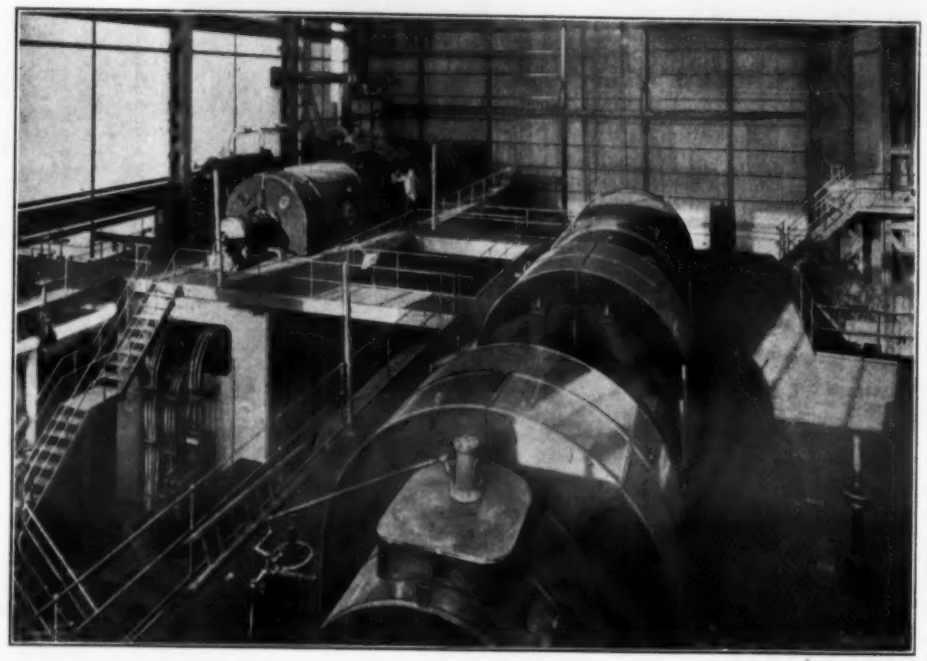
NORTH METROPOLITAN ELECTRIC POWER SUPPLY COMPANY—NEW BRIMSDOWN POWER STATION

MR. J. M. DONALDSON, M.I.E.E., ENGINEER

PULVERISER HOUSE AND POWER STATION

CONTROL ROOM

INTERIOR OF PULVERISER HOUSE



25,000 KILOWATT TURBO-GENERATOR SETS

the fact that the maximum demand was approximately equal to the capacity of the two stations, the demand was found to be growing at the rate of 8000 to 10,000 kW a year, and the Electricity Commissioners were therefore asked to give permission to proceed with the erection of the first section of the new Brimsdown Station. The station, which is now in operation, contains two Parsons 25,000-kilowatt turbo-generator sets, running at a speed of 3000 revolutions per minute, and an interesting feature is that one of the machines generates at a pressure of 33,000 volts. This exceptionally high voltage alternator, which was referred to in our review of the progress in electrical engineering during the year 1926, is believed to be the only alternator of its kind. While small 30,000-volt water wheel alternators were constructed by a continental firm for the City of Rome over twenty years ago, all alternators, with the exception of this new machine at Brimsdown, have since been wound for very much lower pressures.

When the construction of the new Brimsdown Station was begun, the cooling water problem had not been definitely solved. For several years the supply company had been in negotiation with the Metropolitan Water Board with a view to using the water in the King George Reservoir, but at the end of that time no definite understanding had been reached. The station consequently had to be designed so that the pumping plant could deal with water from three available sources, viz., the river Lea Navigation, the King George Reservoir, or from cooling towers. The section of the station now in operation relies on water taken from the Lea Navigation alongside. The inlet is at the extreme north end of the site, where stop posts have been provided to prevent craft entering the inlet, which is connected with a 6ft. underground tunnel, which emerges at the screen pit just north of the pump house, where there are four revolving band screens, each handling the water of one of the pumps. A spray operating on the screens removes the accumulated *débris*, and returns it by way of an outfall channel into a travelling hopper which carries it to an incinerator. There are four circulating pumps arranged for working on two different heads. The pumps designed for the lower head draw the water from the river, whilst the other pumps are capable of working in conjunction with cooling towers or the King George Reservoir, which, however, will not apparently be used. The pumps are driven by induction motors with two sets of poles, giving speeds of 485 and 585 revolutions per minute. At the higher speed the motors develop 430 horse-power, and at the lower speed 260 horse-power. Each pump can deal with a quantity of water corresponding to two-thirds of the capacity of one of the turbines, so that both turbines can be run with three pumps in operation.

Railway sidings pass alongside the end of the pump house, which will be extended westwards when additional pumps are required. Electrically-operated valves inside and outside the station serve for shutting off the pumps and pipe lines and for the future arrangements that will be essential when it is necessary to work the present sets with cooling towers. The water leaves by way of a discharge spillway at the south end of the new station site, and alongside this there is a well for the supply of make up water, which is stored in a large overhead concrete tank. Near this well is a structure which contains the main 33,000-volt earthing resistance, which is connected to the neutral part of three transformers. It should be mentioned that, originally, the specified pressure for both machines was 11,000 volts, and one of the machines has been wound for that pressure, and is connected directly to the 11,000-volt system associated with the old station. All future supplies from the new station will, however, be given at a pressure of 33,000 volts, and the three transformers mentioned have been provided for stepping up from 11,000 volts to that pressure. Broadly speaking, it is not proposed to run the old Brimsdown Station at the same time in the new station. The former will be treated mainly as a reserve, and if one of the 25,000 kW sets breaks down, the old station will take over its load. One of the sets in the old station will, however, always be kept running for supplying the new station with auxiliary power, thus keeping the old station in running order. Normally the new station runs in parallel with the Willesden Station and the County of London Electric Supply Company's Station at Barking.

Under normal conditions the coal is delivered to the station from the London and North-Eastern Railway Company's system by means of a branch siding, but it can also be obtained from the Lea Navigation. In the latter case it is necessary to transfer the coal from a barge to trucks and to pass the trucks along the siding. On its way to the station the coal passes over a weighbridge and the trucks are tipped by an automatic side tippler into a hopper. From the hopper the coal is carried by means of a tray conveyor to a point where it may be discharged, either on to the belt of an endless conveyor which serves to supply the store or on to a magnetic separator and through a crushing machine to one of two bucket conveyors which carry the coal to raw coal bunkers at the top of the pulveriser house. The endless belt which stocks the coal can also be used in the reverse sense; that is to say, for taking it back to the raw coal bunkers, the coal being placed on the conveyor by means of an electrically-driven crane with a fixed jib, running along wide-gauge tracks connected at the west end so that the crane can traverse either of the tracks. The total capacity of the coal store is 20,000 tons, and the coal can be stored to a maximum depth of 10ft. When the pulveriser house is extended northwards a similar arrangement will be provided on the other side, so that the coal handling equipment will then be duplicated.

The top of the pulveriser house, which is a lofty structure, is in the form of a raw coal bin. The raw coal passes down from this bin through a weighing machine, either direct to the pulveriser or through a pair of driers, the drying being done by means of live steam. At present there are three pulverising mills, each having a capacity of about 15 tons per hour. By means of exhausters the pulverised coal is brought into cyclones and it then enters one of two screw conveyors, which carries the pulverised product to one of three Fuller-Kinyon pumps, each having a capacity of 40 tons per hour. The auxiliary air is supplied by two air compressors. From the pumps two pipes serve to convey the powdered coal to the bunkers, which are situated immediately above the boilers. In all there are five bunkers, or one for each boiler. An interesting feature of the plant is a special indicating board which indicates diagrammatically the passage of the powdered coal to each of the bunkers in turn. At present the transmission pipes are underground, but it is intended eventually to carry them overhead to a point in the centre boiler-house and then in either direction to the existing boiler-house on the south and to the third boiler-house on the north. From the bunkers the powdered fuel falls into a feeder system consisting of four duplicate feeders which serve eight Lopulco burners.

Each boiler has a normal capacity of 100,000 lb. of steam per hour at a normal working pressure of 325 lb. per square inch, the temperature of the superheated steam being 750 deg. at the stop valve. The continuous overload rating of each boiler is 125,000 lb. per hour. The ashes are discharged into a sluicing system in the boiler-house basement and pass on to a settling tank, from which they are extracted by an overhead runway and grab which enables them to be taken away either by cart or rail. The space left available by the absence of a sixth boiler has been utilised in various ways. On the ground floor there is a fitters' shop, which is directly served by a spur from the railway siding, whilst the boiler-house and turbine-room staffs are accommodated on other floors. There is an office for the boiler-house engineers, a testing laboratory, turbine test tanks and surge tanks working in conjunction with the condensate and feed pumps. An automatic lift serves all the floors.

The main turbo-generator sets are arranged longitudinally, but instead of being placed in direct line with one another, as in most other stations, where this arrangement has been adopted, they are staggered, a scheme which is claimed to reduce waste floor space and to facilitate the withdrawal of alternator rotors or condenser tubes. In accordance with modern practice, the basement has not been covered in with chequer plate flooring.

The Parsons turbines are of the tandem-cylinder pure-reaction type and are built on the triple exhaust principle. The double-flow low-pressure cylinder has two exhausts and blading similar to that in one half of the low-pressure cylinder is contained in the high-pressure cylinder. There are thus three exhausts, each of one-third capacity. One condenser is made suitable for the combined high-pressure low-pressure blading exhaust and the adjoining low-pressure exhaust, whilst another condenser of half the surface is coupled to the other low-pressure exhaust. The steam conditions are 290 lb. gauge stop valve pressure, 700 deg. Fah. stop valve temperature, and a vacuum of 29in. with the barometer at 30in. Steam is bled from the turbines in order to heat the feed water to a temperature of 265 deg. Fah., and there are two extraction points, the first after the high-pressure blading at a pressure of 9 lb. absolute, and the second at a pressure of 53 lb. absolute. "End-tightened" blading is used throughout the high-pressure turbine, whilst in the three low-pressure portions radial clearance blading is used; all the blading is made of stainless steel. The total external cooling surface of both condensers is 21,500 square feet, and the surface is split up in the ratio of two-thirds to one-third of the total duty for the two condensers. There are two steam jet operated ejector air pumps for each machine, and each ejector is capable of maintaining the required vacuum. The alternators are capable of developing 25,000 kW continuously at 0·8 power factor. The condensers and ejector air pumps were also made by C. A. Parsons and Co., Ltd.

Some time before the work on the new station was begun the main 33,000-volt switchgear was erected, as it was necessary to develop a 33,000-volt system from the old station. This switchgear could not, however, be accommodated in the old station, and it was finally decided to employ switchgear of the outdoor type and to control it in the first place from the old station and afterwards from the new station. The change over of the control cables has been completed, and the switchgear is now controlled from the new control room which is on the third storey of the office building, which also contains a small battery for emergency use, and on the ground floor the main 11,000-volt ironclad switchgear.

The company's officials, Mr. J. M. Donaldson, chief engineer; Mr. W. N. C. Clinch, power station engineer; Mr. C. A. Smeed, chief architect; and Mr. A. H. Jenkins, chief electrical designer, were responsible for the major part of the general design of the steam-raising, generating and ancillary plant, as well as for the structural work.

On page 610 we give views of the pulveriser house and power station, the interior of the pulveriser house, the switch control room, and the 25,000 k.w. turbo generators.

Locomotive Fire-boxes.

THE following passages are taken from two letters addressed to Sir Henry Fowler by Mr. William Palmer, consulting engineer, of Sydney, Australia:—

Some thirty years ago, when the late Mr. T. F. Rotheram was the Locomotive Superintendent, and the late Mr. A. L. Beattie was Locomotive Engineer, Wellington, &c., Sections, I was in charge of the Petone Railway Workshops, distant some 7 miles from the head office, Wellington, hence convenient for experimental work. The fire-box water space and staying thereof in locomotives has been, as you know full well, a continuous source of trouble, and it occurred to Mr. Rotheram to make an experiment on brick lining.

Instructions were duly issued, and an old "M" class Hunslet Engine Company's locomotive was selected for the experiment, I being in charge of the entire programme, including running tests.

Briefly, the alterations made in the existing boiler were as under:—

New ring, about 3ft. long, added to front end of boiler.

Back tube plate removed entirely and replaced by a circular tube plate.

Complete new set of tubes fitted, 3ft. longer than the original length.

Copper fire-box, stays, and foundation ring completely removed, and the fire-box shell plate lengthened by 12in., with butt joint and strap to the original shell plate.

Finally, the whole of the fire-box shell was lined with fire-clay blocks, each about 12in. square—specially moulded to suit the side curvature of shell, an air arch space left at the top, with damper adjustment; the original firehole opening used, but a new set of fire-bars fitted.

I must also mention that the fire-clay blocks had dovetail spaces arranged at their centres for large square headed ¾in. bolts which secured same to the fire-box shell, being equipped with thinned nuts at the sides to clear the framing; a brick arch was also fitted. After attaching the complete fireclay blocks the spaces over the heads of bolts were finally filled with fire-clay and a deflector plate fitted over firehole; the running portion of the engine was merely overhauled, and the working pressure of the experimental boiler was about 130 lb.

The trials were completely satisfactory, and the converted engine was put into regular service on short runs on the Wellington Section, no difficulty whatever being experienced with steaming; to use a common phrase, "She steamed like a witch." Trouble, however, developed after a few days' running, commencing with the square heads of the bolts holding the fire-clay blocks, particularly at the sides, and by looking into the fire-box it was noticed that everything was at a white heat, the vision of same being only permissible by using coloured glasses; the firedoor baffle plate gradually fell at the point and dropped down over the firehole, hence removed. It was also noted that the bolt heads referred to were melting away, and during such process scouring away the fire-clay blocks by vertical channels, much after the manner of a candle when exposed to the wind and with the wick falling to the side.

Difficulty was also experienced in the running-shed after the day's work, owing to the intense heat inherent in the fire-clay lining of fire-box, necessitating a fireman being in constant attendance, practically all night attending to the water supply in boiler.

Owing to the difficulty of maintaining the fire-box lining in a satisfactory condition it was finally decided to discontinue the experiment, and the engine under reference was eventually fitted with a new boiler of the usual type and was used in regular service for many years after.

In the case of the New Zealand Railways, owing to the fire-clay lining of the box giving trouble, we were only able to run the engine for a few weeks, and therefore did not reach the stage calling for trouble with the tube ends. From your very interesting letter it would appear that your fire-clay was much superior to our locally produced material, which, however, gives excellent service with arches obtained from the same locality. I might also mention that the regular practice on the New Zealand Railways is to make the arch lumps in four or six blocks—depending on the size of fire-box—with a round dovetail at centres, and supported by square-bodied studs at the fire-box sides.

Some twenty-five years ago, and owing to the short life of copper fire-boxes, which my chief, the late Mr. A. L. Beattie, blamed to the copper by reason of its being too pure—electrolytic—and not to be compared with the service obtained with the old copper sheets, he decided, on my instigation, to try steel fire-boxes in conjunction with Swedish lap-welded charcoal iron tubes, such at the time being the standard practice in America. Shortly afterwards I resigned from the New Zealand Railways, and for some years I supplied them with the whole of the steel plates and tubes required; the former being obtained from the Luken's Iron and Steel Company, Coatesville, Pa., and the tubes from James Eadie and Sons, Ltd., Glasgow.

The New Zealand Railways have had most excellent service with the Luken's steel fire-box plates, and when discussing the matter with their Mr. G. A. Pearson, chief draughtsman, some two years ago he informed me that they were still using same, but of late years had reverted to copper tube plates in conjunction therewith; they have also adopted solid-drawn steel tubes of British makes.

THE ROLLING STOCK CARRYING STEAMSHIP SEATRAIN

SWAN, HUNTER AND WIGHAM RICHARDSON, LTD., WALLSEND-ON-TYNE, BUILDERS

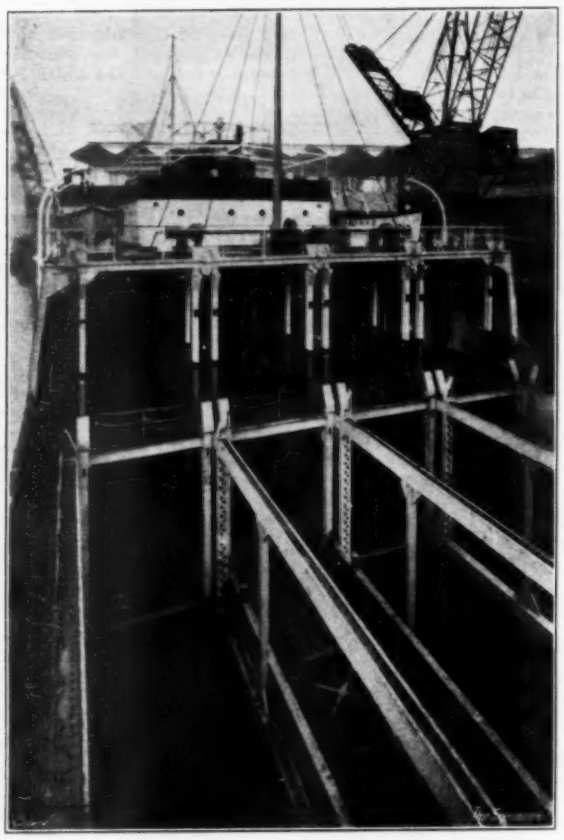


FIG. 1—FORWARD VIEW OF HOLD AND DECKS

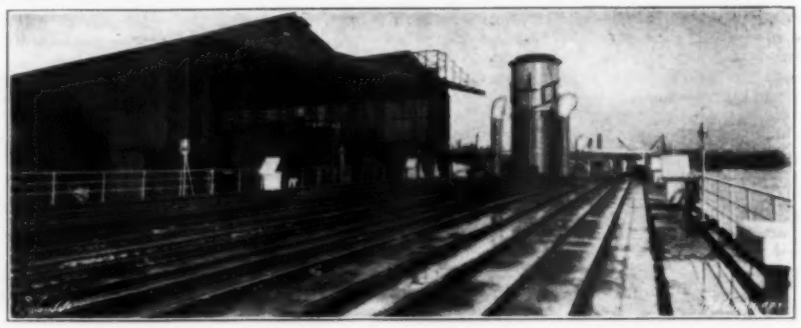


FIG. 2—SUPERSTRUCTURE DECK WITH RAILS FOR WAGONS

FIG. 3—INTERIOR VIEW IN ONE OF THE HOLDS

A Rolling Stock Transport Steamer.

A STEAMSHIP possessing features of especial interest, both to railway engineers and shipping companies, was recently completed by Swan, Hunter and Wigham Richardson, Ltd., of Wallsend-on-Tyne, to the order of Overseas Railways Incorporated, of New York. After undergoing successful trials off the Tyne, she has now proceeded to America. The "Seatrain," as the ship has been aptly named, is specially designed for the transport of loaded railway carriages and wagons, between the ports of New Orleans and Havana (Cuba), the voyage occupying about fifty-two hours. The design of the stowage and loading facilities is different from that usually adopted for train ferries, in that instead of utilising a single deck the loaded wagons are accommodated upon three decks, with empty wagons on the superstructure deck. The arrangement is one which, we are informed, is the subject of American and foreign patents.

The Hull Arrangements.—The ship has a length of 427ft., and is designed to carry a deadweight of 10,500 tons on a loaded draught of 25ft. 9in. The total number of wagons carried is from 90 to 95. Of these about 26 will be stowed in the hold, 26 on the second deck, and 30 on the upper deck, while about 30 empty wagons are accommodated on the superstructure deck. Each of the decks has four rail tracks and suitable hauling and jacking rails are provided. The wagon length varies from 38ft. to 54ft. Fig. 1 shows a general view of the hold and three decks as seen from the elevator shaft in which the loading cradles run. The 'tween deck height in the hold is 21ft. 3in., the upper deck is 16ft. 3in. above the second deck, and the superstructure deck is 17ft. above the upper deck. There is a forecastle with a height of 12ft. above the upper deck, while the poop is 8ft. in height. The view we reproduce in Fig. 2 was taken at the builder's yard looking aft on the superstructure deck, while Fig. 3 shows one of the holds for the rolling stock. The officers are accommodated in rooms below the bridge forward, while the engineers' quarters are aft near the machinery spaces. The crew also have quarters in that part of the ship.

Particular interest is attached to the means provided for the loading and unloading of the wagons. As shown in Fig. 4, there is a single large hatchway amidships, which has a length of 45ft. 8in., and a width of 50ft. There are four cradles which run in guides, and can be lowered or raised to serve any deck. Each wagon to be shipped is first run on to a cradle, which is then lifted bodily by the shore crane and lowered through the hatch to the deck or hold level at which the wagon is to be drawn off. The wagon is then hauled off the cradle and placed in the desired position in the ship, after which it is secured to the rails. As indicated in Fig. 4 there are two steam winches, one aft and one forward, with controls handled at each deck, so that the loading and discharging operations can be quickly carried out. The "Seatrain," which has been built to Lloyd's highest classification requirements, is to be capable of discharging her cargo of wagons and receiving a fresh complement within ten hours.

The Propelling and Auxiliary Machinery.—The main propelling single-screw triple-expansion steam engine was designed and built by the Wallsend Slipway and Engineering Company, Ltd., of Wallsend-on-Tyne. The cylinder sizes are 28in., 26in. and 77in., for the high, intermediate, and low-pressure cylinders respectively, with a common stroke of 54in. With a working pressure of 180 lb. at the boilers the engine has a designed output of 3500 I.H.P. at about 76 r.p.m.

A Weir uniflux condenser is fitted and is designed to be capable of maintaining a vacuum of 26in. under ordinary service conditions. The auxiliary service pumps are driven by links from the main engine. There is a very complete equipment of auxiliary pumps and machinery, which includes a 300 square foot auxiliary condenser for the exhaust steam from the deck and engine-room auxiliary units.

The three 180 lb. multitubular marine type boilers each have a diameter of 16ft. and a length of 12ft., and are designed to burn oil on the Howden-Wallsend system. The total heating surface is about 8400 square feet. The machinery was built to comply with Lloyd's regulations, and throughout its construction both the main and auxiliary machinery and the ship was supervised by John Crookston and Son, of London, on behalf of the owners. The ship left for Havana after her trials on November 14th, and is reported to have passed the Azores safely.

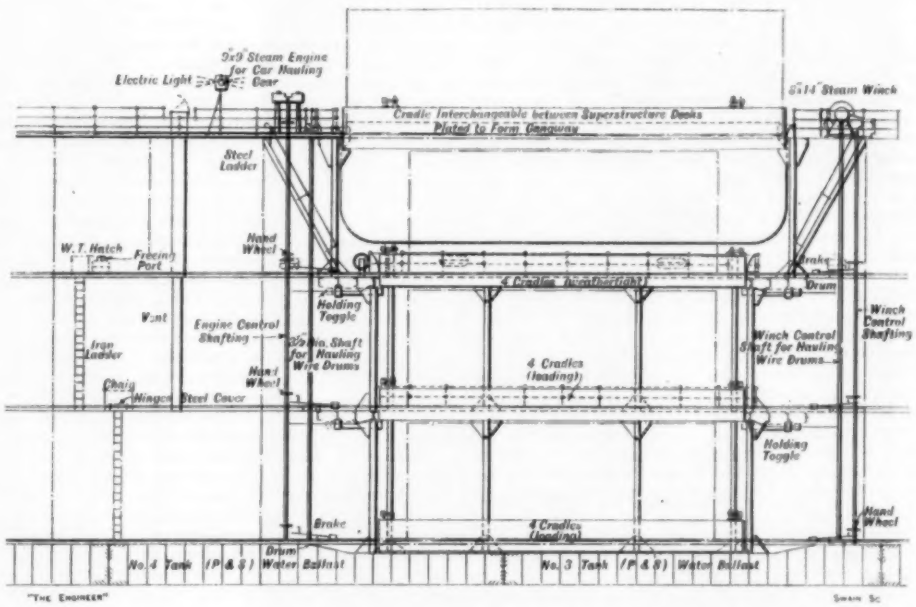


FIG. 4—GENERAL ARRANGEMENT OF LOADING CRADLES

AN 1800 LB. PRESSURE STEAM PLANT.

A WORKS power plant, comprising two triple-expansion steam engines, each of about 6000 horse-power, direct coupled to three-phase alternators and operated by 1800 lb. per square inch high-pressure boilers, has been ordered by the Philip Carey Manufacturing Company, Ltd., of Cleveland, Ohio, for its Lockland works. The firm makes asbestos and magnesium insulating material for high-pressure steam pipes. The designs for the new installation have been prepared by Mr. W. E. S. Dyer, a consulting engineer in Philadelphia, who will superintend its working.

The Combustion Engineering Company of New York is to supply the 1800 lb. pressure boiler plant, which will be fired with pulverised fuel and will include integral economisers, water-cooled furnace walls and superheaters. The two vertical triple-expansion steam engines, which

are possibily the largest back-pressure engines of their type, will be built by A. Borsig G.m.b.H., of Berlin-Tegel. Each engine is to have a designed output of about 6000 horse-power at 225 revolutions per minute, when supplied with steam of 1400 lb. pressure at the stop valve, and at a total temperature of 800 deg. Fah. The working back pressure against which the engine will exhaust is to be 60 lb. per square inch.

The arrangement of the engine cylinders is an interesting one. There are two high-pressure single-acting cylinders, each of 360 mm., or 14¼in. diameter, and two intermediate-pressure cylinders, also single-acting, each of 540 mm., or 21¼in. diameter. Each pair of cylinders will operate on a single crank, and the third crank will be connected to the double-acting low-pressure cylinder, which will have a diameter of 850 mm., or about 30½in. The stroke of the engine is to be 650 mm., or nearly 25⅝in. There will be an intermediate superheater between the intermediate-pressure and low-pressure stages, which will be fed by live steam under thermostatic control. The valve gears for the high-pressure and intermediate-pressure cylinder will be of the piston valve type, with Hochwald valve gear on the low-pressure cylinders. The efficiency of the installation is stated to be a very high one.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Diminishing Demand.

BUSINESS in the iron and steel industries in the Midlands and Staffordshire has gone decidedly quiet of late, and even taking into account a certain amount of business which is coming to local mills that under normal conditions would go to foreign suppliers, there is hardly sufficient to keep plants running at their present rate of production. Buyers appear to be holding off the market. It may be that they have satisfied their consumptive requirements for the time being, and that seems to be the prevailing impression. If it is so, new business of any bulk is hardly likely to be forthcoming until the New Year. This is generally a quiet period of the year for the heavy industries, activity in this area being chiefly noticeable in the lighter trades manufacturing goods for Christmas sales. Even in that direction, however, business is now slackening off, orders being near completion. Returning to the heavy trades, constructional engineers, though they are still receiving a number of small contracts, report that there is a decided tendency for business to slow down. Makers of heavy forgings and stampings in this area speak of a similar state of affairs. The brightest branches of engineering at date are mechanical engineering, where there is a steady increase of the amount of business in hand, and electrical engineering. In the latter a large number of inquiries is being received, and many of them, it is hoped, will materialise in the near future. In some departments of engineering in the Black Country hopes run high, but little increase in activity is now generally expected this year.

Railway Rates Relief.

Industrialists hereabouts are now weighing the possibilities of cheaper prices for iron and steel as the result of the coming reduction in transport rates. Many consumers on 'Change in Birmingham to-day—Thursday—expressed the opinion that they would come in for a large portion, if not the whole of the subsidy. They made it abundantly clear that they expected to share largely in the benefits accruing from the reduction in railway costs, and in many cases intimated that they were postponing buying on that account. Business is quiet with a large number of them. They have fair stocks with which to carry on, and have no necessity to secure additional supplies at the moment. Iron and steelmasters do not quite see eye to eye with the users of materials. They have in numbers of cases been selling recently at rates which have shown but small profit, and they are looking to placing business on a more economic level before conceding price reductions.

Tube Manufacture by New Process.

Extensions on a large scale are, I learn, to be made in the near future at Coombs Wood Tube Works, Halesowen. Contracts have been entered into by Messrs. Stewart and Lloyds with a Manchester firm for the erection of engineering workshops which are to cover an area of approximately two acres, and 600 tons of steel work will be required for the framework. An official at Coombs Wood Works states that the buildings are to be utilised for the manufacture of tubes by a new process. It is, however, I understand, intended, if possible, to keep the present workshops engaged with the old method, at least for a time.

Pig Iron.

There has been no revival of pig iron buying in this district during the week, and the present limited output is more than enough to satisfy consumers' requirements. Further efforts have been made to beat down prices, but they have met with little success, smelters generally adhering to recent quoted rates. Here and there, in isolated cases, concessions are said to have been made where attractive orders have been the subject of negotiation, but there is no general giving way on the part of either Derbyshire or Northamptonshire smelters. Profits are too lean at present, they claim, to justify any reduction in selling rates. Whether the forthcoming reduction in transport costs will bring about lower prices is a matter for speculation. At date it is stated that the bulk of the orders being given out for pig iron are going direct to the furnaces, merchants being unable to find buyers. Forward contracting is rarely heard of, buying being purely to satisfy current needs. Derbyshire No. 3 foundry is quoted £3 to £3 1s. and forge £2 16s. Northamptonshire foundry is quoted at £2 16s. to £2 17s. 6d. and forge £2 13s. 6d. East Coast hematite is named at £3 10s., but some makers are able to command a better price owing to a more active market. Midland smelters talk of further curtailment of production unless demand improves in the near future.

Steel.

Sales of finished steel material this week have been but poor, and the quietude recorded last week in this branch of the market is unrelieved. As a matter of fact, it was reported on 'Change to-day—Thursday—that the call for steel for constructional engineering had fallen away further, there being an almost entire absence of bulk purchases. Heavy steel prices continue unchanged at £7 17s. 6d. for joists and £8 12s. 6d. for plates. The plate makers are working short time owing to the poor demand from shipbuilding interests. Very little improvement can be recorded in the half-products branch, and rollers of billets and bars have not experienced the expansion of business the Ruhr *impasse* led them to expect. So far as can be discerned there is no stringency of note, though foreign supplies are not promised for delivery this year. Belgian material is being delivered against old contracts with fair regularity, but orders placed now must await the New Year for execution. Some German steel is on offer for delivery after production has been resumed. The terms quoted are a few shillings higher than those which applied before the lock-out. Consumers in this district do not appear desirous of doing business on these terms. Native billets continue to be quoted £6 7s. 6d. to £6 10s., though it is stated that there are Birmingham merchants prepared to sell at below the former figure. Some works have booked useful orders, but the demand under the circumstances is disappointing. In small steel bars the price varies according to the time allowed for delivery, but the minimum is £7 15s.

Staffordshire Bar Iron.

Demand for Staffordshire bars shows little or no improvement, and conditions generally are unchanged. A good tonnage of marked iron continues to be sold at £12 per ton, but makers are not at all satisfied with the rate at which new business is being received. For special engineering purposes this class of iron is always in request, while freedom from competition is a further factor acting to the benefit of Staffordshire marked bar sales. Keen competition in Crown iron comes from Derbyshire and Lancashire, and prices vary a good deal according to district. Staffordshire values are around £9 10s. Crown iron is, however, obtainable at as low as £9 2s. 6d. Local makers claim that there is no comparison in the quality of the material they make and some of that sold as Crown bars by other outside makers. Staffordshire common bars for the nut and bolt and hurdle trades are in poor request, consumers being disinclined to pay £8 12s. 6d. to £8 17s. 6d., the price demanded by makers. Although continental quotations have practically disappeared, small quantities of Belgian iron for nut and bolt making, at £7 5s. delivered, are still coming in, and as long as this is obtainable there seems little chance of local ironmasters making sales. Ironmasters who have turned to the re-rolling of steel are fairly busy, and are competing with considerable measure of success against the steel works. Production of wrought iron strip for the tube trade is maintained at a moderately good level, and makers have no difficulty in disposing of their output at £10 15s. to £10 17s. 6d. Black Country tube makers are hardly so well employed as they were, however, and some doubt is expressed as to whether demand for tube strip will be maintained. It is hoped that additional orders will come in to the works in the near future.

Galvanised Sheets.

The galvanised sheet trade has fully recovered its position, and prices of 24-gauge corrugated sheet remain steady at the reinstated price of £13 10s. For immediate or early supplies mills now ask up to £13 15s. Most of the district mills have good order books, sufficient to carry them through this year, and new business booked at £13 10s. is mostly for January delivery. Demand for lighter gauge sheets and black sheets is good, and prices are steady at recent rates. Business in this district in tin-plate is rather backward. This may be partly due to the fact that tin-plate wasters have again been brought within the scope of the control. The basis of odd sizes has been fixed at 15s. 4½d., with 20 by 14 at 15s.

Rolling Stock.

Midland rolling stock establishments are fairly well employed at the moment, but additional contracts are required to ensure steady and continuous employment. Some very acceptable orders have been secured of recent weeks, the latest being one by the Birmingham Railway Carriage and Wagon Company, Ltd., of Smethwick, for the coachwork, underframes and bogies for thirty motor-coaches for the Metropolitan Railway Company.

Unemployment.

Although there is a decrease in the Birmingham area of the number unemployed in the Midlands slight increases in other places, such as Northampton, make the total larger by 322 than it was last week. The number of workless in the area now stands at 173,329, of whom 129,519 are men, 36,897 women, 3674 boys, and 3239 girls. Other towns where decreases are recorded this week are Bilston, Coventry, Dudley, Leamington and Warwick, Leicester, Peterborough, Smethwick and Walsall.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Tramways Manager.

A SPECIAL meeting of the Manchester Corporation Tramways Committee which was held on Monday for the purpose of selecting a new tramways manager to fill the vacancy caused by the death of Mr. Henry Mattinson, was eventually adjourned without any of the candidates being interviewed. The list of applications had been reduced to three, the short list comprising the names of Mr. H. R. Kiernan, chief constructional engineer of the Manchester tramways; Mr. R. S. Pilcher, general manager of the Edinburgh tramways; and Mr. H. P. Stokes, general manager of the Plymouth tramways. Both Mr. Pilcher and Mr. Stokes had travelled to Manchester to appear before the members of the Committee, but owing to the sudden indisposition of Mr. Kiernan it was decided to adjourn the meeting until the following day. On Wednesday the Committee decided to extend the "short list" to five and to invite Mr. J. S. D. Moffatt, of Salford, and Mr. A. L. Fearnley, of Sheffield, to meet the Committee, along with the other selected candidates for the position, at a further meeting to be held yesterday.

The Lancashire Coal Merger.

The agreement providing for the amalgamation of six of the leading coal-producing concerns in Lancashire was ratified by a meeting of shareholders in Manchester on Tuesday of Messrs. Andrew Knowles and Sons, one of the constituent companies. Remarking on the deplorable condition of the coal trade, the chairman expressed the view that the best remedy lay in the amalgamation of interests, where it could be shown that such an arrangement could be made mutually beneficial. Among the more obvious advantages to be gained from the proposed merger, it was pointed out, were the centralisation of sales and the avoidance of unnecessary and wasteful competition. By judicious distribution, much could be saved in transport charges and in avoiding overlapping, and the scheme did not necessarily mean that the coal consumer would have to pay more. An interesting statement made at the meeting was to the effect that the Bridgewater Collieries, another of the constituent concerns, own very large areas of unworked coal—"probably larger than any other colliery in Lancashire, and possibly in England."

County Developments.

By far the most important announcement this week respecting engineering developments in this part of the country has been the statement that the contract for the construction of the full-sized tunnels on the Birkenhead side of the river Mersey in connection with the new Liverpool tunnel scheme, has been placed with Sir Robert McAlpine and Sons, London. Information concerning several other minor prospective schemes has been published during the past few days. Subject to Blackpool sharing the cost, the Preston Electricity Committee proposes to spend a further £93,000 on the laying of two additional lines along the existing route of supply from Preston power station to Blackpool. It is also announced that the Blackburn Sewerage Committee is to consider a proposal to spend about £120,000 on reconstruction work, a scheme which would provide three years' work for about 300 men. At Prestwich, near Manchester, on Tuesday, a Ministry of Health inquiry was held in connection with the proposal of the District Council to extend the sewage works at a cost of £12,000.

Metropolitan-Vickers' New Shop.

Members of the Manchester and District Circle of the British Electrical Development Association attended a demonstration of workshop lighting on Thursday of last week at the Metropolitan-Vickers Electrical Company's new West Works, Trafford Park, Manchester, when a lecture was also delivered by Mr. R. C. Hawkins. The new department is an assembly shop for high-tension switchgear, and is a huge building covering an area of about 94,000 square feet. The lighting arrangements that have been installed are very effective, and in the main body of the shop consist of about 120 lamps, 25 per cent. being of 1000 watts and the remainder of 500 watts each.

Non-ferrous Metals.

Except that lead remains steady at the level at which it stood a week ago, the non-ferrous metals generally continue their firmer tendency. This is particularly pronounced in the tin section, that metal having experienced one of its periodical and spectacular spurts. Dealings in tin have been on a much bigger scale, although a large proportion of the business has been speculative in character. The market closed very firm last week-end, and prices continued their upward movement in the early days of the present week, values on balance being between £7 and £8 a ton higher than at last report. A fair volume of buying interest has also been shown in copper. There has been no change in quotations for refined descriptions, but in the case of standard metal, although there have been occasional periods of slight easiness, prices at the moment of writing are a shilling or two higher than they were a week ago. Spelter has attracted rather more attention than of late, and values have continued to move up steadily. Compared with about a month ago, when the signs of renewed steadiness in this section became apparent, current quotations represent an advance of more than £1 a ton. A quiet business has been reported in lead, but last week's advance has been maintained.

Iron and Steel.

Pig iron consumers on this market are placing occasional orders for forward delivery, but, generally speaking, the demand at the moment is slow, and in a good many instances users who have contracts against which to draw are not too ready to specify for deliveries. On the whole, however, the supply position is not oppressive, so far as Midland varieties of pig iron are concerned, and although occasional orders are being booked at shaded prices, offers keep fairly steady at 67s. 6d. to 68s., delivered Manchester or equal, for Staffordshire and Derbyshire, with North-East Coast brands at 79s., Scotch at 87s. 6d. to 90s., and hematite at 82s., delivered Lancashire. A rather better trade is being done in common bar iron for the nut and bolt manufacturing industries, but the demand for Lancashire Crown and second quality bars shows little improvement, though values keep steady. Sales of steel materials to local constructional engineers are on a disappointing scale, and the call for boiler and tank plates

is also subdued, about the only relatively bright spot in the market just now being the rather better demand for small bars, which keep very firm at from £8 to £8 2s. 6d. per ton, according to quantity. Other quotations, also, are well held, with sections at £7 17s. 6d., ship and tank plates at £8 12s. 6d., large bars at £8 17s. 6d., and boiler plates at £9 10s. to £9 15s. per ton, according to quality. Foreign steels are no easier, but the high prices of these and the delivery difficulties operate against an active market, and business is slow.

Electric Traction on Railways.

A paper dealing with electric traction on railways was read before the Manchester Association of Engineers on Friday last by Mr. R. Brooks, B.Sc., M.I.E.E. In the course of his paper the author discussed the application of electricity to the operation of suburban services and to specific types of main line sections, and the choice of system—alternating current or direct current—was dealt with. The general features of the principal types of equipment for motor coaches and locomotives were described, with notes on current collection and regenerative braking. There was also given a brief description of the more important types of transmission gear, from the motors to the axles of locomotives, and their suitability for different services was discussed. The author said that one of the main factors which had delayed the extension of electrical operation was the high capital cost of conversion. One prominent authority had given a figure of £25,000 per mile of double track for a suburban system, the actual train equipments being provided out of the locomotive renewals fund. The approximate number of electric locomotives in use in different parts of the world, according to the author, are as follows:—North America, 479; South America, 80; Europe, 1655; and other countries, 200.

BARROW-IN-FURNESS.

Hematite.

An impetus has been given to the pig iron trade in this district by the improvement in the demand for iron by customers who have been buying from Germany, and also from the Continent itself. This demand is brought about by the dispute in Germany, and can in a way be described as a flash in the pan. Nevertheless, the business is welcome, and enables the makers to clear all their make and get rid of any stocks which remained. The home demand, apart from the extra business, keeps steady and prices are inclined to stiffen a little. There is less local demand, owing to the temporary stoppage of the steel works at Barrow. Special qualities are in fair demand, and the Continent is a customer for these irons. The pig iron trade is about the same, and there will be no improvement unless more furnaces are put in blast. Foreign ore is in moderate demand. The steel trade is dull, and the steel departments have closed down for a short period. It is not known how long they will be idle, but it is thought at present that they will be at work again before the end of the year. Certain repairs and overhaul of plant are taking place in the interim. The hoop works are fully engaged and likely to be.

SHEFFIELD.

(From our own Correspondent.)

Some Active Lines.

On the heavy side of the steel trade there is much activity in the cheaper classes of material, and also in several special lines, but the general position is unsatisfactory. The falling off of foreign competition in soft steels is proving of much benefit to this neighbourhood, and still more so to North Lincolnshire. Something not far short of full capacity is being worked at the large furnace plants at Parkgate and Templeborough. A sign of the activity in the Scunthorpe district is that overtime working has had to be adopted at Lysaght's, who are busy on large contracts for the South Wales tin-plate mills. The United Strip and Bar Mills and the Templeborough Wire Rod Mills are working very well. There has been such a demand for good class rope wire for the last six or seven weeks that the local drawers are scarcely able to keep pace with it. They are sending a considerable proportion of their output abroad. There is an increasing sale for steels which resist corrosion, special forgings, steel for motor vehicles, cold-worked material, such as bright drawn bars, strip and wire. Good employment is reported at the works of Vickers-Armstrongs and Metropolitan-Vickers, with the probability of repeat orders.

And the Reverse.

There is, however, another side to the picture. The railway steel departments are still poorly employed, and there is little expectation of increases in the requirements of the home companies next year. It is difficult to sell best qualities of acid steel, and work at the rolling mills and forges is on a declining scale. The demand for wire ropes is poor. In several directions there has been a notable falling off in the booking of new orders and the receipt of inquiries, and a period of greater slackness during next month is feared. It may be that the approaching end of the year has something to do with the downward movement, or, as has been suggested to me, the prospect of lower railway freights may be partly responsible for it.

A Rail Mill to Close.

The railway and tramway rail mill at the Ickles (Rotherham) works of Steel, Peech and Tozer is to be closed down, involving the dismissal of between 200 and 300 men. The mill has been in operation a long time, and has made rails for all the principal railways and tramways of the world. The decision to close it has been taken in accordance with the new policy of the United Steel Companies of co-ordinating the work of the various branches, and concentrating as far as possible the manufacture of specific products in the particular works where costs are lowest. It is understood that while the demand for rails is on its present restricted scale orders will be executed at other mills in the combine.

New Steel-hardening Process.

Two of the largest Sheffield firms—John Brown and Co., Ltd., and Thos. Firth and Sons, Ltd.—have acquired the patent rights in a novel process called "Nitrard," by which special steels can be surface hardened at a low temperature by the absorption of nitrogen from ammonia gas. The development of the patents in Great Britain and her Dominions is to be carried out by a company known as Nitralloy Ltd., which has been formed with offices in Sheffield. This company intends to establish plants to carry out case-hardening for the trade, and also to grant licences to large users to install plants at their own works. The process is only applicable to the "Nitralloy" special steels, and the sole licences to supply these have been granted to Messrs. Brown and Firth. It is stated that the invention is likely to have far-reaching and beneficial effects in machine design. It is already being extensively employed in America, France and Germany in the automobile, aviation, and many other branches of engineering. The process consists in subjecting finish-machined parts of the special alloy steels known as "Nitralloys" to the action of ammonia gas at the low temperature of 500 deg. Cent. for the period of time necessary to produce the depth of case required.

A Busy Furnace Firm.

A state of considerable activity is reported at the works of Verdon Cutts and Co., Ltd., of Sheffield, makers of electric furnaces. The orders which they have on hand include a 120-kW electric furnace for heat treating carbon, alloy, and special steels; 50-kW brass-melting furnace; 16-kW Babbitt melting pots, for colonial railway shops; a 24-kW electric hardening furnace for Sheffield steel works; a 85-kW brass-melting furnace for metal extrusion for Doncaster; a 50-kW electric furnace for forging and heat treatment of rock drills in Canadian mines; a new type electric assay or cupellation furnace for a colonial mint; a 120-kW electric furnace for normalising and hardening drills, tools and rock drill parts in a South African gold mine; a 35-kW electric furnace for heat treating rock drill parts in a colonial mining area; an electric furnace for case-hardening, carburising, heat treatment, &c., of rock drill parts on the Rand; a 10ft. electric furnace for heat treatment of continuous strips of special alloy steel in a Sheffield works; a large electric furnace for heat treatment and annealing of billets and blanks for a colonial mint; and two electric furnaces for the heat treatment of gold and silver coinage blanks for mint purposes.

Cutlery, Plate, and Tools.

The flow of orders for the Christmas season trade in cutlery and plate has dwindled considerably. In the case of a good many works they have ceased altogether, and no substantial amount of business from other sources is expected this year. At some works the orders have been executed, and at others they are approaching completion. The seasonal trade appears to be ending rather abruptly, and earlier than usual, and a number of operatives have been thrown out of work. The demand from the cheap bazaars, however, is said to be greater than ever, and there is also quite a substantial trade in the most expensive qualities of silver, plate and cutlery. Trade in the very best pocket cutlery is good. Although the demand for cutlery from many overseas markets has fallen off, there have been useful orders lately from Holland, South America, and India. In the tool branches a good deal of slackness prevails. This is especially true of the saw and file departments, which are exceptionally quiet for the time of the year. A fair amount of activity is to be found in the engineers' small tool trade, and buyers are showing a decided preference for quality goods. In the tool trades generally the preponderance of orders is on the small side, and competition is so keen that in many transactions the prices are hardly remunerative.

Orders for Trawlers.

Two trawlers of the latest type are to be built by Cochrane, Ltd., of Selby, for J. Marr and Son, Ltd., one of the largest fishing firms at Fleetwood. They will show progress in tonnage, engine power and coal capacity. Messrs. Amos and Smith, of Hull, are supplying the engines, which will be of approximately 700 horse-power, as compared with an average of 600 in the present boats of the Fleetwood fleet. The two trawlers will cost close upon £35,000. The first of them is to be delivered in May next and the second in June.

Grimsby's New Dock.

The project of a new fish dock at Grimsby has been definitely advanced a stage by a decision of the Town Council to give notice of its intention to promote the necessary Bill in the next session of Parliament. The estimated cost is £1,388,000. As previously reported, the proposal is that the Council should build the dock and then lease it to the L.N.E.R. Company, which will pay an annual rent sufficient in thirty years to cover the sinking fund and interest.

Large Road Schemes.

Several interesting road schemes are in prospect in Yorkshire. At Malton there is a strong desire for the construction of a by-pass road to relieve the pressure of traffic through the town. Several proposals have been made, and an expenditure of about £100,000 is suggested. The Malton and Norton Urban Councils have decided to ask the County Council surveyors to co-operate in the preparation of estimates, so that definite proposals may be submitted to the County Council and the Ministry of Transport. At Scarborough it is proposed to carry out an improvement of Mere-lane, from Seamer-road to Oliver's Mount-road, and the Town Council has decided to ask the Government to make a grant towards the cost, which is estimated at about £35,000. Bradford Corporation is anxious to carry out two schemes, involving a total expenditure of £46,120, for the relief of the unemployed, and details have been placed before the Unemployment Grants Committee.

Electricity Contracts.

The generating station of the Scarborough municipal electricity department in Seamer-road is to be extended, the Electricity Commissioners having given their consent to the installation of new plant. The Electricity Committee of the Town Council recommends that the following tenders be accepted:—International Combustion, Ltd., London, one 3000-kW, three-phase, 50-cycle turbo-alternator and auxiliary plant, two water-tube boilers and one cooling tower, £46,302; Fred Whitaker and Co., Ltd., Leeds, buildings and spillway, £2636.

NORTH OF ENGLAND.

(From our own Correspondent.)

Shipbuilding Revival.

So often has the prophecy of "better times ahead" been made with regard to the industries in the North of England that one is apt to minimise the good news of trade improvement when it does eventually come. But there seems to be no doubt that at last the shipbuilding industry is taking on a new lease of life. The Wear and Tees builders have been more fortunate than those on the Tyne. With the exception of an important order received by the Palmer Shipbuilding Company for a 12,000 tons motor ship for the Blue Star Line, and two cargo vessels booked by J. Readhead and Sons, South Shields, Tyne builders have experienced a lean time during the past week or two, while other areas have been securing work. It is understood that well over twenty new orders have been placed at West Hartlepool and on the Tees, and the new contracts given out to Wear firms approach about a dozen. This week, Smith's Dock Company, South Bank, announced an order for six vessels, each 253ft. long. They are for Canadian owners, and are to be used for grain carrying on the Great Lakes. The prospect of more work being forthcoming is favourable, as there is still a considerable number of inquiries circulating for new tonnage. Local owners are included in the enterprising spirit which shipowners are now showing, and already one or two have definitely placed contracts. For many months past shipbuilders have almost begged work in order to keep their yards going, and have taken orders without any hope of profit. They have, moreover, repeatedly pointed out to shipowners that they could not expect a more favourable time for building. Now, with prospects of improved trade all round, and several owners looking ahead and placing orders, other owners who have hesitated have had to consider the question of obtaining the delivery they wanted, and also whether prices are likely to go up. In this latter respect, while there are no indications at present of prices hardening, it cannot be expected from a business point of view that shipbuilders can continue to build with practically no margin of profit.

Cleveland Iron Trade.

Business development in the Cleveland pig iron trade is slow, but it is encouraging to notice gradual movements in the right direction. A good deal of interest continues to centre in the deadlock in the German iron and steel industries. While suspension of operations at works in that country has not had the effect on trade in this district that might have been expected it has eased competition, and assisted materially to strengthen the position of Cleveland producers. Apart, however, from whatever influence conditions in Germany may have on the Cleveland market, a welcome movement in the direction of genuine business expansion is proceeding, and there is a growing opinion that, at length, steady trade development has commenced. Makers report that the output of marketable iron is readily taken up. A very large proportion of the production goes into direct consumption at producers' own works, the needs of which promise to increase, and there is a likelihood of another idle furnace or two being rekindled shortly. Fixed prices are steadily upheld, No. 1 Cleveland foundry iron being 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

East Coast hematite pig iron is still very scarce. Continental consumers are not disposed to follow the upward movement in prices, but are taking a fair amount of iron against running contracts, and home customers are reported paying the rates asked. Stocks have been reduced to trifling quantities. Production will be increased in the New Year by the rekindling of one or two furnaces. Meanwhile there is threatened difficulty in satisfying moderate current needs. Quotations are not definitely fixed, but values are based on round about 71s. for ordinary qualities.

Ironmaking Materials.

Although business in foreign ore continues on the quiet side, merchants are taking a firmer stand. Freights are stiffening, and there seems likelihood of consumers having to pay full market values for anything they are compelled to buy. Prices are at the equivalent of best Rubio at 22s. 6d. c.i.f. Tees. Blast-furnace coke of good average quality keeps at 17s. 6d. delivered to works on the North-East Coast, with inquiry slightly better.

Manufactured Iron and Steel.

The outlook in the manufactured iron and steel trade is distinctly brighter. Business is on a much better scale, and semi-finished steel finds quite a ready market. Prices of continental makes of semis are no longer competitive in home markets with products of this area. Recent orders for ships have stimulated trade in quarters that have been none too well employed of late. Specifications for shipbuilding requisites are now being distributed fairly freely; steel for constructional engineering is in good

request ; railmakers have a considerable amount of work on hand ; and sheet manufacturers have contracts arranged that will keep them busy for several months. Prices all round are firm but unchanged.

The Coal Trade.

There is no special movement in the Northern coal trade generally, but the recent position is on the whole well maintained, and fitters of all classes continue to take a cheerful view of the outlook. The market is firm for all grades of steams, the prospective output being very heavily booked, and production is of substantially increased volume with every prospect of it holding to the turn of the year. The leading qualities of Northumberland coal are difficult to get for next month, but so far as can be gathered there is not much buying into next year. This, of course, is easily to be understood in view of the higher freights and appreciated fuel prices. Best Northumberland steams are now at a minimum of 14s. 3d., and other qualities are quoted round about 13s. 6d. Steam smalls are doing better, but would welcome more trade. The Durham gas coal trade position is encouraging. Demand is steadily expanding, and many brands are fully sold, although there is still a good volume of supply available ; but, on the whole, prices hold steadily. Best qualities are quoted at 14s. 9d., and seconds at 13s. to 13s. 6d. Coking sorts are becoming more active, and there are some large bunker sales for export pending. The coke export trade is slowing down. Makers are booked up for their full output, but the contractors find difficulty in arranging for early clearance, mainly owing to scarcity of tonnage, and consequently prompt supplies are offering freely. Best gas coke is 19s. 3d. to 19s. 6d. ; patent oven cokes, 18s. 3d. to 18s. 6d. ; and beehive and special grade cokes, 23s. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

Aluminium Works Extension.

IMPORTANT extensions are being carried out at the Burntisland works of the British Aluminium Company. It is estimated that the developments will double present outputs, which have not been sufficient to meet demands. An extensive series of brick buildings has been constructed and in all probability the new works will be in operation early next year.

More Shipbuilding Orders.

Two cargo steamers of 6800 tons deadweight have been ordered by Glasgow owners, and will be built at Ardrossan, and Messrs. N. E. Moss and Co., Liverpool, have placed an order for two cargo steamers. It is reported, however, that final details of the latter contract have yet to be arranged.

Steel and Iron.

The position in the Scottish steel and iron industries has not appreciably changed during the past week. Some of the steel works have now more orders on hand, due in a measure to recent shipbuildng contracts, and it is expected that further improvement will be noticeable within another month or two, if several similar contracts pending meantime are duly fixed up. Export demands for steel have maintained their recent improvement. Re-rolled steel bars continue in good demand. This is due in a measure to the trouble in Germany, and for the same reason re-rollers have to pay more for raw materials which they usually obtained from the Continent. If the trouble in Germany were to last much longer, re-rollers would be forced to rely to an increased extent on local products, with a consequent increase in costs. Meanwhile, prices of re-rolled steel bars are firm at £7 15s. per ton, home and export. Steel sheet makers are busy in light sheets and galvanised varieties. Tube makers are busy in most branches. Bar iron is dull, and the same may be said of pig iron. Prices of these materials are unchanged.

Exports and Imports.

During the past week 10,000 tons of iron ore, 5700 tons of iron and steel products, and 800 tons of pig iron were unloaded at Glasgow Harbour. Within the same period shipments of steel and iron products amounted to 6000 tons and pig iron to 677 tons ; the former going to the Colonies, South America, China, and Spain.

Coal.

The Scottish coal market remains firm, owing to the restriction of outputs. Home demands are only moderate, while export business is slow, despite fair inquiries, as foreigners will not, as a rule, accept the terms offered. With the outlook uncertain, exporters are not disposed to consider speculative buying, consequently business is confined to comparatively small sales. Meanwhile, Lanarkshire ells and splints, Lothians steams and Fifeshire first and third-class steams, are firm and supplies difficult to arrange, owing to comparatively small outputs. Washed nuts are unsteady, with trebles and doubles firm in some districts, notably Fifeshire, and singles and pearls in Lanarkshire. Aggregate shipments amounted to 206,215 tons, against 230,524 tons in the preceding week and 242,630 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE past week or so has proved a very trying time for all concerned in the export of coal. The terrible weather which has prevailed has played havoc with tonnage, and completely upset the loading arrangements of the collieries. Vessels which were expected to make dock in the course of twenty-four or forty-eight hours have been held up for days, and have had to shelter all round the coast. In one case, a vessel has taken thirteen days to come from Liverpool to this Channel. Some steamers which left a Welsh port were found a week after still taking shelter off Lundy Island. In the past few days many shipowners have not been able to charter their steamers, owing to the fact that they have been unable to gauge their position and their possible readiness to load. At the end of last week there were forty-two idle tipping appliances at the various South Wales docks, and there was not much improvement in the position on Monday, inasmuch as there were thirty tips at a standstill. Collieries have had a very difficult time, as in many cases, although well sold on paper, their tonnage has not turned up. It is not surprising to find in all the circumstances that shipments last week were not very satisfactory. The total was just over 382,000 tons, as against rather more than 388,000 tons in the preceding week. It is to be feared that the total for the whole of this month will compare very unfavourably with the quantity for October. Still, a fair amount of business is passing, not so much for early loading as for forward positions. On January 17th prices will be tendered for 380,000 metric tons of locomotive coals for the Egyptian State Railways, for delivery at Alexandria from February to August. The railways have extended the list of Monmouthshire coals which they will accept. A fair amount of new business is reported to have been done for South America, and the Portuguese State Railways are in the market for about 50,000 tons for delivery at the end of this year and during the early part of next at Lisbon and Oporto. The Palestine Railways are also understood to have bought, while a Cardiff firm has contracted for the supply of about 10,000 tons of sized coals for delivery at Casablanca over the next three months.

Withdrawal of Tipping Appliances.

Another sign of the depressing times which are being experienced is to hand in the proposal of the Great Western Railway Company to close down the working of six tips on the west side of the East Dock at Cardiff as from December 3rd. The proposal has caused quite a stir among the trading community and the workers at the docks. It will, of course, mean that a certain number of men will become unemployed, but the Great Western Company, which has spent very considerable sums in the maintenance and the improvement of the docks in this district, is compelled to economise in view of the falling off in trade. Its view is that trade does not warrant all the tips at the docks being manned, inasmuch as shipments can be effected very easily at the other docks. The subject came up for discussion at a special meeting of the Cardiff Chamber of Commerce on Tuesday, when representatives of practically all the commercial organisations in the city were present. The point of view of the railway company was fully explained, and it was stated that the withdrawal from service of the six tips in the East Dock would mean that on an average twelve appliances instead of eighteen would be idle daily at Cardiff, Penarth and Barry. The members of the Chamber of Commerce agreed with the Great Western Company's proposal, but the Lord Mayor of Cardiff said the company's action would not be satisfactory to the Parliamentary Committee, which would oppose it. It was promised by the representative of the company that consideration would be given to the suggestion that in view of the possible loading pressure before Christmas and in the interest of the workmen, the tips should not be withdrawn from service until January 3rd.

Engineering Exhibition.

The seventh annual Exhibition organised by the South Wales Institute of Engineers was opened at the Drill Hall at Cardiff on Wednesday of last week, and will continue open to December 1st. The opening ceremony was performed by the President, Mr. Wm. O'Connor, and each day the Exhibition has been well attended. There is no sign of depression so far as the Exhibition is concerned ; on the contrary, there is evidence on all sides that no effort has been spared to improve machinery and equipment of all descriptions for the benefit of the mining industry. The hall has been crowded with stalls taken by the leading engineering undertakings in the country. A new feature of the Exhibition was the steel prop section. There were over forty exhibits of new forms of pit props to replace wood, some of them being submitted by men engaged in the mining industry, engineers and working miners. Many of the exhibits are of composite form, covering a combination of steel tubes and timber to take the squeeze.

Current Business.

Operations for prompt loading have been rather quiet during the past week on account of the fact that tonnage has been such a difficult factor. Many pits have had to work irregularly owing to the outlet for coals being restricted through tonnage getting right out of position. The feature of the market has been the firmness of dry sized coals, but otherwise all qualities have been freely obtainable, and prices have remained round about the minimum. The demand for patent fuel continues to be quiet, and as regards pitwood the tone of the market is easier, prices being about 28s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

BARR, THOMSON AND CO., Ltd., engineers, of Netherton Ironworks, Kilmarnock, ask us to announce that as from November 13th, 1928, their telephone number will be Kilmarnock 791 (two lines).

MR. L. F. NORRIE asks us to announce that he has started business on his own account as a manufacturing engineer, under the firm name and style of L. F. Norrie and Co. at 30, South Fort-street, Bonnington, Edinburgh.

MR. JAMES W. CAMPBELL, M.Sc., A.M.I. Mech. E., who has been appointed Secretary of the Institution of Gas Engineers, requests that all communications should be addressed to him at the Institution, 28, Grosvenor-gardens, Westminster, S.W. 1.

CONTRACTS.

VICKERS-ARMSTRONGS Ltd. have received from Lever Bros., Ltd., an order for two pairs of steel lock gates for the new dock at Bromborough.

BELLISS AND MORCOM, Ltd., of Birmingham, have received from the North-Eastern Marine Engineering Company an order for four 100-kW Diesel-driven auxiliary generating sets, for a vessel now being built for Messrs. Alfred Holt and Co., by the Caledon Shipbuilding Company.

ROBERT STEPHENSON AND CO., Ltd., of Darlington, and 25, Victoria-street,. Westminster, London, S.W. 1, have received from the Bengal and North-Western Railway Company, Ltd., an order for two locomotive engines and tenders similar to the six the same company recently ordered from them.

THE GENERAL ELECTRIC COMPANY, Ltd., has received an order from the Manchester Corporation Tramways for thirty 500-volt tramcar motors, each of 50 horse-power on the one-hour rating, together with sixty tramcar controllers for controlling two 50 horse-power motors ; and an order for six tramcar electrical equipments, each equipment including two 500-volt tramcar motors of 41 horse-power on the one-hour rating, for the Walthamstow Tramways.

THE PARSONS OIL ENGINE COMPANY, Ltd., of Southampton, has recently received the following orders :—(*a*) From the Fairfield Shipbuilding Company, Ltd., for two 60-kW emergency generating sets for the new C.P.S. liner "Empress of Japan" ; (*b*) from Swan, Hunter and Wigham Richardson, Ltd., for three emergency lighting sets, two of 15 kW for French owners and one of 18 kW for Swedish owners ; (*c*) for four sets of Parsons standard Board of Trade machinery of 28–32 H.P. type for the motor lifeboats to be carried by the new steamers being built in Japan for the Nippon Yusen Kaisha ; and (*d*) for a 14 H.P. Parsons engine direct coupled as a generating set for the motor ship "Anglo-Canadian" which is being built for Lawther, Latta and Co., Ltd.

LAUNCHES AND TRIAL TRIPS.

REIJNST, passenger and cargo steamer ; built by the Netherland Shipbuilding Company, to the order of the Koninklijke Paketvaart Maatschappij ; dimensions, 290ft. by 43ft. by 21ft. 3in.; 2450 tons. Engines constructed by Werkspoor ; launch, November 24th.

OILBELIANCE, single-screw motor tank vessel ; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of British Oil Shipping Company, Ltd.; dimensions, 424ft. by 53ft. 5in.; 8650 tons of oil cargo. Engines, set seven-cylinder Neptune Polar Diesel engines ; constructed by the builders ; launch, November 27th.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—At the ordinary meeting of the Institution of Electrical Engineers, to be held at 6 p.m. on Thursday next, December 6th, Sir George Sutton, Bart., will present to the Institution an oil painting of Wheatstone by Sir William Llewellyn, K.C.V.O., R.A. At the same meeting there will be presented to the Institution by Mr. R. W. Paul an oil portrait of Volta painted by Signor G. Palanti, of Milan.

UNAUTHORISED USE OF INSTITUTION INITIALS.—On Friday, November 16th, in the Chancery Division, before Mr. Justice Maugham, counsel on behalf of the Institution of Electrical Engineers, in an action brought against Thomas Ronald Shaw, trading as Shaw, Fletcher and Co., at 3A, King-street, Wrexham, moved for an injunction to restrain the defendant from making use of the initials "A.M.I.E.E." or any other initials or designations implying that he is a member of the Institution. His lordship said that unless Mr. Shaw were a member of the Institution he could not use these initials. The defendant did not oppose the motion. Counsel asked for a perpetual injunction and the delivery up of all documents on which the defendant had used the initials "A.M.I.E.E." Some time ago the defendant, counsel stated, had been a student member, but his name had been struck off the registers, and he had never been an associate member. He kept saying he would stop using the initials, but had not done so. His lordship granted the injunction and said that defendant must pay costs to date. There was no order for damages, these not being sought.

PORT ISAAC HARBOUR.—It was reported at the November meeting of the Cornwall County Council that it had been found impracticable to construct the outer breakwater in connection with the Port Isaac Harbour scheme, on the site proposed, without incurring large additional expense, as the bottom had latterly been found to be unsuitable. The contractors had felt unable to continue their work, disputes had arisen between them and the Harbour Commissioners, and the contractors had issued a writ against the Commissioners claiming, *inter alia*, about £9000 damages. Steps in the action were being taken, and costs were being incurred by the Commissioners. Consultations had been taking place between the Commissioners, the engineers and representatives of the Government, and proposals were now under consideration for the construction of the outer breakwater on another site near low water mark. The work on the inner breakwater was proceeding. The finance committee reported that if the revised scheme now under consideration was carried out, the cost might be approximately the same as that of the original scheme, though, of course, the harbour would be smaller and less efficient. If any additional expenditure was involved it was probable that it would be borne by the Government. The Port Isaac Harbour scheme is primarily designed to assist the fishing industry.

INSTITUTION OF NAVAL ARCHITECTS' SCHOLARSHIPS.—The following scholarships will be offered for competition in 1929 :—*Naval Architecture :* Martell Scholarship (£130 per annum), Fairfield Scholarship (£150 per annum), and the Denny Scholarship (£75 per annum) ; *Marine Engineering :* Parsons Scholarship (£150 per annum). The above scholarships are tenable at certain universities or colleges for the period of years shown below :—

University or college.	Scholarship.			
	Martell.	Fairfield.	Denny.	Parsons.
Glasgow	4	4	4	4
Durham	3	3	—	3
Liverpool	3	3	—	3
Royal Naval College	3	3	—	—
City and Guilds	—	—	—	3
Royal Technical College, Glasgow	—	—	—	3

The Denny Scholarship is open to boys under nineteen years of age (British subjects) from public or secondary schools who have not yet begun their apprenticeship. The remaining scholarships are open to British apprentices or students between the ages of eighteen and twenty-three who have not yet entered upon a university course. Full particulars may be obtained from the Secretary, Institution of Naval Architects, 2, Adam-street, Adelphi-terrace, London, W.C. 2.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	17/- to 19/-
(1) Spanish	21/-
(1) N. African	21/-
N.E Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 11 0	3 11 0
No. 1	3 12 0	3 12 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 16 0 to 2 17 6	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 6	—
No. 4 Forge	2 17 6	—
Basic	3 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a); 4 2 6 (b); 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0 .. 13 12 6 to 13 15 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 15 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	8 0 0 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	9 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	6 17 6 and 7 12 6	—
Soft Basic	6 10 0 to 6 12 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 10 0	—
Midlands		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 7 6 to 6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/1½
Block Tin (cash)	239 2 6
,, (three months)	236 0 0
Copper (cash)	68 6 3
,, (three months)	68 12 6
Spanish Lead (cash)	21 1 3
,, (three months)	21 6 3
Spelter (cash)	25 5 0
,, (three months)	25 10 0
Manchester—	
Copper, Best Selected Ingots	73 17 6
,, Electrolytic	75 10 0
,, Strong Sheets	98 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	22 15 0
,, Foreign	21 10 0
Spelter	25 17 6
Aluminium (per ton)	£107

FERRO ALLOYS.

Tungsten Metal Powder	1/9½ per lb.
Ferro Tungsten	1/5 per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£37 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£42 0 0	17/-
,, ,, ,, carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/- per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
,, ,, Ell	16/-
,, ,, Splint	16/3 to 17/-
,, ,, Trebles	14/9 to 15/6
,, ,, Doubles	13/9 to 14/-
,, ,, Singles	12/6 to 12/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	16/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/3
Screened Navigation	18/-
Trebles	15/6 to 16/6
Doubles	13/- to 13/3
Singles	12/9
Lothians—	
(f.o.b. Leith)—Best Steam	13/- to 13/6
Secondary Steam	12/9
Trebles	15/6
Doubles	13/6
Singles	12/9

ENGLAND.

(8) N.W. Coast—	
Steams	25/-
Household	38/6 to 51/-
Coke	22/-
Northumberland—	
Best Steams	14/3
Second Steams	13/- to 13/6
Steam Smalls	9/-
Unscreened	11/9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	14/9
Second	13/3 to 13/6
Household	21/- to 27/-
Foundry Coke	18/6 to 19/6

Sheffield—	Inland.
Best Hand-picked Branch	26/- to 27/6 —
Derbyshire Best Bright House	23/- to 24/6 —
Best House Coal	20/6 to 21/6 —
Screened House Coal	17/- to 18/- —
,, ,, Nuts	16/- to 18/- —
Yorkshire Hards	14/6 to 16/- —
Derbyshire Hards	14/6 to 16/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	4/6 to 6/- —
Smalls	3/6 to 4/- —
Blast-furnace Coke (Inland)	13/6 at ovens —
Furnace and Foundry Coke (Export), f.o.b.	19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/3
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/ to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/-
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	18/- to 20/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	28/- to 28/3
Swansea—	
Anthracite Coals:	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 28/6
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	17/3 to 18/-
Breaker Duff	8/- to 8/6
Rubbly Culm	10/- to 10/3
Steam Coals:	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	12/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Aviation.

The Air Minister has presented to the Chambers of Commerce the outlines of the programme which he will soon be introducing to the Chamber of Deputies for the reorganisation of commercial aviation. He proposes to link up Paris with all the principal European capitals; to extend the air system along the Mediterranean to Syria and join it up with the British air line to India and on to Indo-China; and to continue the line from France to Buenos Aires to Santiago in Chili. In order to increase the value of air services, experiments will be carried out with night flying, for which purpose an elaborate system of lighthouses will be installed between Paris and London and between Paris and Marseilles. At the same time there will be three companies for international services, the Compagnie Générale Aéropostale which organises the traffic with Africa and South America, the Air Union for the services between London and Marseilles, and the two companies which at present carry out air communication with Berlin and Constantinople will probably be amalgamated. In all cases it is proposed to eliminate the aeroplane manufacturing interests which at present control the companies. The reason why the Air Minister has approached the Chambers of Commerce is that he looks to them to provide the air stations, particularly those that will be created for putting towns into communication with the international lines. Concessions will be granted to the Chambers of Commerce, which will provide the grounds and lay them out, while the State will take charge of the equipment, and both will contribute to the expense. A first experiment will be made with the line from Geneva to Bordeaux by way of Lyons and Limoges, which the railway companies are to carry out in collaboration with the various Chambers of Commerce and the State.

Coal.

An arrangement has been come to between the coalowners and the miners in the Nord and the Pas de Calais, whereby wages are adjusted on a new basis that represents an appreciable advance. Contrary to what consumers had feared it is affirmed that this step will not necessitate an increase in the price of coal, although the higher wages will certainly make it more difficult for the colliery companies to compete with imported fuel. Notwithstanding the approach of winter there is little diminution of the heavy stocks, and an inquiry in the colliery district shows that the situation is far from satisfactory. Coalowners had counted upon the aid offered them by the Government to dispose of their fuel in the south-west of France, where the British have a monopoly of the trade. The attempt to ship coal from Dunkirk to Bordeaux and other ports has failed because there are no return freights, and it is therefore almost impossible to compete with British coal.

Flood Protection.

During the past month the flooding of the Grésivaudan plain by the Isère caused so much damage that the committee of experts, which was formed more than two years ago to examine the various schemes for dealing with the freshets of that Alpine river, has issued a report recommending the immediate carrying out of preliminary works. At present the only protection is that afforded by the embankments which were made in 1860. Since then the level of the river has risen as the result of an accumulation of rocks brought down by the occasional torrential masses of water. The first recommendation of the Commission is to raise the embankment and to drain the low lying country, either by extending the present system of collectors or by installing pumping stations as suggested by Messrs. Schneider & Cie., of Creusot. The latter scheme receives approval if only the local bodies can be relied upon to keep the plant in good order, and it is proposed to instal a few such pumping plants as an experiment. In any case, it is urged that the work of raising the embankment should be started upon without delay. This cannot be regarded as a permanent remedy so long as the bed of the Isère continues to rise with the accumulation of rocks. The Commission believe that dredging would be too costly an operation in view of the value of the land to be recovered, and it proposes to make a trial of crushing the rocks at certain points where they are brought down by the freshets so that they can be carried away by the strong current.

Machine Tools.

In a general way machine tool makers are fairly busy, but, as in all other branches of the machinery trades, they are becoming uneasy at the prospect of considerable quantities of machine tools being imported from Germany on account of reparations. The Government has long come to the conclusion that it must take full advantage of the Dawes arrangement to enable it to develop the country's economical equipment and the only check upon the quantity of machinery and material thus obtained from Germany is the effect it may have upon the home manufacturing industries. The motor car firms see that their only chance of keeping out foreign competition is to improve their manufacturing facilities, for which purpose they must replace a considerable amount of machinery in their factories, and while probably paying as much for the German machine tools as they would for the French, if they were obtainable, they are nevertheless allowed particularly favourable conditions by the Government which give less importance to the question of cost than is usually the case. Thus negotiations have been proceeding for a long time past between the Association of German Machine Tool Makers and a group of French motor car firms for the placing of an order for machine tools to the value of several millions of marks. The idea is to equip the French motor car factories with the most modern plants so that they will be in an equally good position for turning out vehicles economically as the Americans who are threatening this market. This cannot be done without the aid of German reparations, and for that reason it is believed that the present negotiations will be carried to a successful issue.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

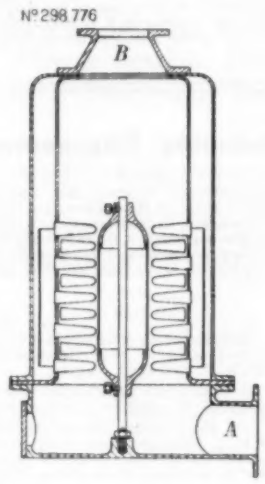
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

298,776. October 21st, 1927.—Exhaust Heat Boilers, H. F. Marriott, 1, Broad-street-place, London, E.C. 2.

This invention relates to steam generators or water heaters of the kind comprising an annular water chamber having short closed-ended tubes or thimbles projecting radially into a central heating space through which hot gases are passed. In accordance with the invention a relatively large part of the central space of the heater is left free from thimbles, so as to permit expansion of the exhaust gases and to reduce back pressure.

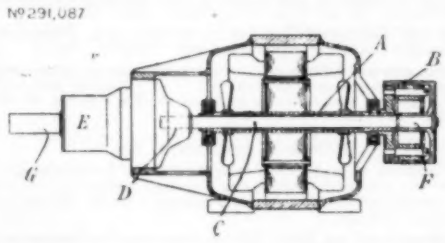


The portion of the water heater free from thimbles may be arranged at the upper end of the heater and adjacent to the outlet for the exhaust gases to the atmosphere, thus permitting expansion of the gases immediately before delivery to the atmosphere. It will be observed that the thimbled portion of the water heater and the portion free from thimbles provide a combined water jacketed silencer and heat combing device. The inlet for the exhaust gases is shown at A and the outlet to the atmosphere at B.—*October 18th*, 1928.

DYNAMOS AND MOTORS.

291,087. April 28th, 1928.—Improvements in or relating to Electric Motors with a Centrifugal Coupling, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.*

This invention concerns an electric motor with reducing gear built directly into the motor housing and having a centrifugal coupling mounted on the end of the motor remote from the reducing gear. The three-phase motor shown is provided with a squirrel-cage rotor fixed on the hollow shaft A which is carried in the ball bearings and carries at its right-hand extremity the centrifugal coupling B of known design. The hollow shaft

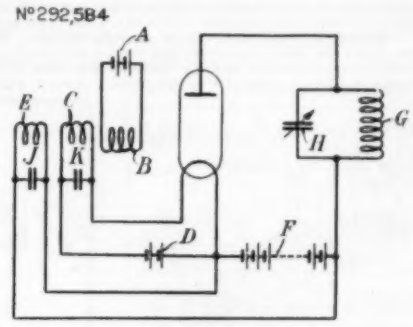


encloses the shaft C, the left-hand extremity of which D engages with the reducing gear E, which may be designed as a planetary gear, and is incorporated in the housing of the motor. When a certain speed is reached the right-hand end F is connected through the centrifugal coupling with the rotor shaft A, which forms at its two extremities a bearing journal for the internal shaft C. The machine to be driven at a reduced speed is coupled to the shaft end G of the reducing gear, while the exterior of the centrifugal coupling B constitutes a pulley from which a belt drive can be taken at a different speed from that of the shaft G.—*October 11th*, 1928.

TELEGRAPHS AND TELEPHONES.

292,584. May 31st, 1928.—Means for Maintaining Constant Frequency in Electric Oscillation Generators, C. Lorenz Aktiengesellschaft, of 1, Lorenzweg, Berlin-Tempelhof, Germany.

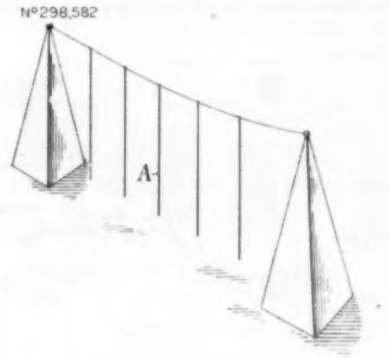
The object of this invention is to remove or to reduce the fluctuations of frequency depending upon the variations of the "negative resistance." This result is obtained by causing the factors determining the variations of the value of the "negative resistance" to react with one another in such a way that the original variations are balanced. In the valve shown only the anode and cathode are indicated. The battery A produces the constant magnetic field for the tube in a coil B, which, in association with an electric field, causes the negative current potential characteristic between the anode and the cathode. Another coil C is traversed by the heating current of the heating battery D, whilst the coil E receives its current from the anode battery F. The oscillatory circuit, consisting of a self-induction coil G and capacity H arranged in current resonance, is connected to the anode and cathode. In order that the coils C and E should not be traversed by high-frequency alternating currents condensers J and K are connected in parallel with them. All three coils B, C and E produce together the magnetic field which is necessary for operating the valve. If, for example, for any reasons the heating current diminishes in strength, then it would cause a variation of the "negative resistance" r of the valve. Since, however, the heating current at the same time helps to determine the magnetic field, a further variation of r is caused. The number of turns and the direction of winding of the coils B and C are selected in such a way that the variations of the "negative



resistance" caused by the variation of the heating current and by the variation of the magnetic field mutually cancel one another, and consequently the frequency of the oscillation produced remains constant. Exactly the same applies to the variations of the anode potential, the effect of which upon the "negative resistance" is balanced, in similar manner, by the auxiliary field of the coil E. In this case the dimensions of the coil E and the sense of the winding with respect to the coil B are selected in such a manner that a practically complete compensation takes place.—*October 11th*, 1928.

298,582. May 11th, 1927.—Improvements in or relating to the Reception of Radio Signals, John Logie Baird and Baird Television Development Company, Ltd., both of Motograph House, Upper St. Martin's-lane, London, W.C. 2.

Wireless waves, and particularly those of short wave length near the infra-red part of the spectrum, are susceptible to refraction and diffraction in the same way as luminous radiation, by the use of appropriate devices, and this invention contemplates the production of a spectrum of radiated wireless waves by suitable means. The drawing illustrates diagrammatically a diffraction grating constituted by a number of conductors A

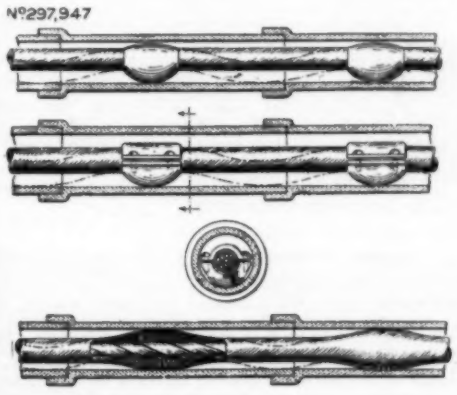


which are spaced apart a distance comparable with the wave length of the radiation, say, about half the mean wave length, the row of conductors lying substantially normal to the direction from which the radiation comes. The effect of this grating on the wireless waves is exactly similar to that of a diffraction grating on visible light, so that a spectrum is formed behind the grating with the various wave lengths regularly spaced apart. A wireless receiver of any suitable construction is arranged in the spectrum and receives only the particular wave length in that part of the spectrum, all other wave lengths being diverted away from the receiver.—*October 11th*, 1928.

TRANSMISSION OF POWER.

297,947. September 3rd, 1927.—Improvements in or relating to Electric Cables or Attachments for Use in Connection Therewith, Callender's Cable and Construction Company, Ltd., and Philip Vassar Hunter, both of Hamilton House, Victoria Embankment, London, E.C. 4.

According to this invention, instead of the conduit being furnished with saddles or supports, the cable itself is provided

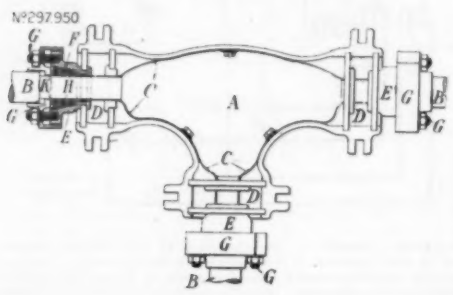


at suitable intervals with girdles or enlargements, so that it is normally clear of the conduit and can sag when it expands under continuous maximum load, the girdles or enlargements being preferably so proportioned and spaced that when the cable thus sags it just rests on the floor of the conduit. These girdles or enlargements may form an integral part of the cable—*i.e.*, they may be incorporated in the sheathing or covering of the cable

during its manufacture or they may be in the form of detachable members, which are secured to the cable at the requisite intervals when it is being laid or drawn into the conduits. Three forms of construction are shown, which are more or less self-explanatory.—*October 4th*, 1928.

297,930 September 8th, 1927.—Improved Bonding Device for the Lead Covering of Electric Cables, Harry Francis Jackson Thompson, of 65, Cambridge-mansions, Cambridge-road, Battersea Park, London, S.W. 11.

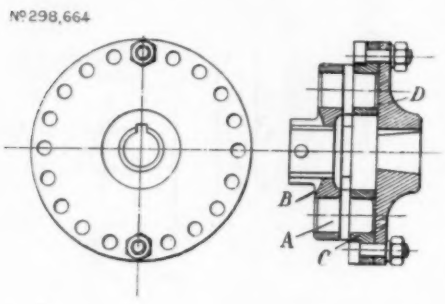
This specification describes a method of joining or connecting which can be quickly and easily carried out, and one which will maintain good electrical connection. The box A has three openings for the cables B and usual copper earthing strips C. The drawing shows the cables cut across and not joined together as they would be in practice, and the bitumen chambers D are shown empty. The bonding device comprises a gland E with a



tapered bore F and a flanged cap G, the centre of which lies in the wider end of the tapered bore. This flanged cap is held to the gland by screws and nuts G in such manner that by tightening the nuts the plug-like centre of the cap is pressed inwardly and compresses the rings of lead H between which are springs K, which are also compressed and maintain pressure on the lead. The lead is shown in rings of varying diameter, and arranged in tapered fashion, but it may be in helical form, so as to make good contact against the wall of the tapered bore and the ends of the copper bonding strip. The springs K may be of any suitable kind, such as coil springs, the convolutions of which are diametrically resilient.—*October 4th*, 1928.

298,664. July 13th, 1927.—Flexible Shaft Couplings, W. H. Dorman and Co., Ltd., 43, Foregate-street, Stafford, and R. S. Stafford, 151, Oxford-gardens, Stafford.

This coupling is intended for such purposes as driving magnetoes. In it flexibility is provided by hard rubber studs A, with central collars, pressed into holes in the two flanges B

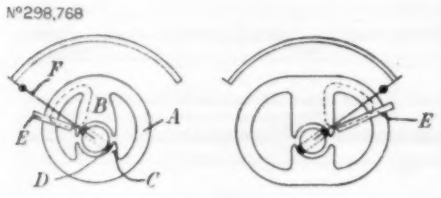


and C of the coupling. The flange C is fixed on to its shaft by an intermediate flange D and the two are bolted together as shown. One flange has twenty holes and the other eighteen, so that they can be set angularly, with regard to one another, in divisions of $^{1}/_{180}$ of a circle.—*October 15th*, 1928.

MEASURING AND TESTING INSTRUMENTS.

298,768. October 11th, 1927.—Improvements in and relating to Moving Coil Electrical Instruments, Wilfred Holmes and Ferranti, Ltd., both of Hollinwood, Lancaster.

It is common practice to provide moving coil instruments with a magnetisable piece which can be set in position to shunt a predetermined portion of the magnetic flux traversing both pole pieces. While effective in obtaining a modification of the scale readings as a whole, the scheme is not effective in modifying the scale at any desired part. According to this invention, means are provided whereby a greater latitude in the disposition of the scale readings is obtained. The invention consists briefly in a moving coil electrical instrument including a magnetisable member so mounted as to be capable of shunting a portion of the magnetic field from one pole piece only. A permanent magnet in the shape of an annulus A is provided with two more or less radial pole pieces B and C, the pole piece B being consider-

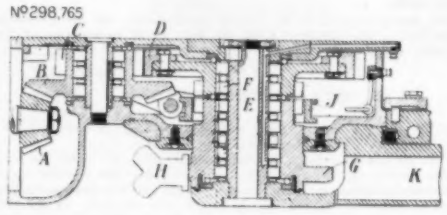


ably longer than C. The moving coil D is accordingly pivoted to rotate about an axis which is not concentric with the axis of the permanent magnet A. An iron screw or other suitable magnetisable member E is so arranged as to effect a shunting of part of the flux traversing the longer pole piece B, the shunting being caused to take place at one side of the pole piece. In operation, when the indicating pointer F is at zero, as is indicated, part of the moving coil rests in a magnetic field which is somewhat depleted on account of the shunting explained above. As the pointer moves over the scale, however, this part of the moving coil enters the normal field; thus the scale divisions at the commencement of the deflection are concentrated in comparison with those at the succeeding portion of the scale. Obviously, by arranging the magnetisable member to shunt the flux from the opposite side of the long pole piece, as is illustrated in the right-hand drawing, a reversed concentration of scale divisions will be produced. If desired, both sides of the long pole piece may be shunted.—*October 18th*, 1928.

MINING MACHINERY.

298,765. October 5th, 1927.—Coal-cutting Machines, The Diamond Coal-cutter Company, Ltd., Stennard Works, and H. Tinsley, Cap Frehel, Sandal, Wakefield.

In this arrangement of the driving gear for a chain type coal-cutter, the drive is transmitted through the two bevel wheels A and B, and the pinion C to the gear wheel D. This wheel



revolves on a fixed pin E, on roller bearings F. The sprocket G, for the cutting chain H, also has roller bearings. The gear wheel D and the sprocket G are separate, but may be connected together by the clutch J. The jib K is held up to frame of the machine by the flange on the bottom of the fixed pin E.—*October 18th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Automobile Engineers: Scottish Graduates.—Regent Restaurant, 51, West Regent-street, Glasgow. "Brakes," by Mr. W. P. Kirkwood. 8 p.m.

Institution of Electrical Engineers: South Midland Centre.—Grand Hotel, Birmingham. Annual dinner. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Thomas Lowe Gray Lecture. "The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine," by Professor W. E. Dalby, F.R.S. 6 p.m.

Institution of Production Engineers.—At the Society of Motor Manufacturers and Traders, 83, Pall Mall, S.W. 1. "Psychology as an Aid to Production," by Dr. G. H. Miles. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Informal meeting. "The Manufacture of Decorative Metal Work," by Mr. C. W. Harvey. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Frictional Resistance and Ship Resistance Similarity," by Dr. E. V. Telfer. 6 p.m.

SATURDAY, DECEMBER 1st.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. "The Venting of Dry Sand Moulds," illustrated by lantern slides, by Mr. E. Flower. 4 p.m.

MONDAY, DECEMBER 3rd.

Institution of Automobile Engineers.—Merchant Venturers Technical College, Bristol. "Experiments on Self-energised Brakes," by Major C. G. Nevatt. 6.45 p.m.

Institution of Electrical Engineers: South Midland Centre.—The University, Edmund-street, Birmingham. "Practice and Progress in Combustion of Coal as Applied to Steam Generation," by Mr. F. H. Rosencrants. 6.15 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

University of London, University College.—Chemistry Theatre, Gower-street, London, W.C. 1. "Chemical Engineering Education and Research in Great Britain," by Dr. W. E. Gibbs. 5.15 p.m.

TUESDAY, DECEMBER 4th.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. "Electric Furnaces," by Mr. A. Glynne Lobley. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. "The Gezira Irrigation Scheme: Canalisation of the Gezira," by Mr. Harmood Victor Carruthers Johnstone; "Sluices and Machinery of the Gezira Irrigation Scheme; Blue Nile Dam and Canalisation," by Mr. James Robertson Russell. 6 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. "Gear Transmission," by Dr. H. E. Merritt. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "Diamonds," Lecture III., by Sir Wm. Bragg, F.R.S. 5.15 p.m.

WEDNESDAY, DECEMBER 5th.

Institute of Metals: Swansea Local Section.—Thomas Café, High-street, Swansea. "Refractories," by Mr. R. M. Doidge. 7 p.m.

Institution of Automobile Engineers: Derby Graduates' Branch.—Joint meeting with the Derby Society of Engineers. Technical College, Derby. "The Heat Treatment and Mechanical Properties of Alloy Steels," illustrated by lantern slides, by Mr. J. H. Dickenson. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Students' meeting. "The Renewal and Strengthening of Railway Bridges," by Mr. John Wishart Fairlie Gardner. 6.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Attenuation of Wireless Waves Over Towns (Effect of Towns, including Buildings, Tuned Aerials, &c., on Wave Damping)," by Mr. R. H. Barfield and Mr. G. H. Munro. 6 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Mappin Hall, Sheffield. "Power Developments, Past, Present and Future," by Professor F. C. Lea. 7.30 p.m.

Institution of Sanitary Engineers.—Denison House, 296, Vauxhall Bridge-road, Victoria, S.W. 1. "Non-corrodible Steels and their Application," by Mr. J. A. Clements, F.I.C. Illustrated with lantern slides. 6.30 p.m.

Northampton Engineering College Engineering Society.—St. John-street, E.C. 1. "Modern Road Construction," by Mr. B. L. Stephenson. 5.15 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-on-Tyne. Graduate Section. "Feed-water Heaters," by Mr. H. A. Morham. 7.15 p.m.

Royal Society of Arts.—John-street, Adelphi, London W.C. 2. "Fuel for Ships," by Sir Eustace Tennyson d'Eyncourt F.R.S. 8 p.m.

THURSDAY, DECEMBER 6th.

British Association of Refrigeration.—The Hall of the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "Research Carried Out for the Engineering Committee of the Food Investigation Board During 1927," with lantern illustrations, by Dr. E. Griffiths, F.R.S., to be followed by discussion. 5.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. "The Continuously Loaded Submarine Telegraph Cable," by Messrs. A. E. Foster and P. G. Ledger and Dr. A. Rosen. 6 p.m.

FRIDAY, DECEMBER 7th.

Institution of Electrical Engineers.—First meeting of the recently formed Meter and Instrument Section. Paper, "Load Levelling Relays and their Application in Connection with Future Metering Problems," by Mr. W. Holmes. 7 p.m.

Institution of Engineering Inspection.—At the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Application of Electro-deposited Metals to Engineering," illustrated by lantern slides and exhibits, by Mr. C. H. Faris. 5.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster. Informal meeting. "Works Committees," by F. E. Robinson. 7 p.m.

Institution of Water Engineers.—Apartments of the Geological Society, Burlington House, W. (1) "The Consumption and Waste of Water, by Mr. John Bowman, M. Inst. C.E.; (2) "Legal Considerations relating to the Administration of Engineering Contracts," by Mr. E. J. Rimmer, A.M. Inst. C.E.; (3) "The Sandfields," by Mr. A. W. Burtt; (4) "The Corrosive Attack of Moorland Water on Concrete," by Messrs. W. T. Halcrow, M. Inst. C.E., G. B. Brook, F.I.C., M.I.M.M., and R. Preston. 10.30 a.m.

Junior Institution of Engineers.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Presidential address, by Lieut.-Col. J. T. C. Moore-Brabazon. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Combustion and its Difficulties in Marine Oil Engines," by Mr. K. O. Keller. 6.30 p.m.

SATURDAY, DECEMBER 8th.

Institution of Civil Engineers: Birmingham and District Association.—Visit to Muntz's Metal Company, Ltd., at French Walls, Smethwick. Members should assemble at the works at 9.30 a.m.

MONDAY, DECEMBER 10th.

Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Scottish Moulding Sands and their Application to Non-ferrous Casting," by Mr. R. Hudson. 7.30 p.m.

Institution of Automobile Engineers.—Joint meeting with Institution of the Rubber Industry, Blackfriars Theatre, William-street, London, E.C. 4. "The Tire as an Article of Manufacture and Usage," by Mr. W. H. Paull. 7.30 p.m.

Institution of Automobile Engineers.—Queen's Hotel, Birmingham. "Experiments on Self-energised Brakes," by Major C. G. Nevatt. 7 p.m.

TUESDAY, DECEMBER 11th.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, London, E. 1. "Practical Refrigeration for Ships," by Mr. A. Greenfield. 6.30 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry. "Experiments on Self-energised Brakes," by Major C. G. Nevatt. 7.30 p.m.

WEDNESDAY, DECEMBER 12th.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Informal meeting. Subject for discussion, "Methods of Reducing Temperature in Deep Mining Work," by Mr. James Whitehouse. 6 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Applications of Electricity to Medical Practice," by Mr. G. G. Blake. 8 p.m.

THURSDAY, DECEMBER 13th.

Institute of Metals: Birmingham Local Section.—In the Engineers' Club, Waterloo-street. "Magnesium Alloys for Engineering," by Mr. E. Player. 7 p.m.

Institute of Metals: London Local Section.—Joint meeting with the Institute of British Foundrymen, in the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "Aluminium-silicon Alloys: Their Properties and Some Applications," by Mr. R. B. Deeley. 7.30 p.m.

Institution of Civil Engineers: Yorkshire Association.—Hotel Metropole, Leeds. "Notes on Power Station Construction," by Mr. A. H. D. Markwick. 7.30 p.m.

FRIDAY, DECEMBER 14th.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. "Comparison of English and French Moulding," by Mr. S. Stanworth. 7.15 p.m.

Institute of Metals: Sheffield Local Section.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square. "Chromium Plating," by Mr. L. Wright. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Locomotive Boiler Washing Plant," by Mr. E. J. M. South. 7.30 p.m.

SATURDAY, DECEMBER 15th.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Sackville-street, Manchester. "The Application of the Microscope to the Study of Metals and Alloys," by Mr. G. Mohn. 7 p.m.